The Neighbourhood Social Environment and its Role in Adolescent Alcohol Use and Drinking Motives

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Abstract

In Scotland, adolescent alcohol consumption represents a major public health concern. The overarching aim of this research was to identify neighbourhood characteristics associated with adolescent alcohol use behaviours and motivations for drinking with a focus on the neighbourhood social environment.

A systematic review identified and synthesised studies that operationalised the neighbourhood social environment from the adolescents' perspective. Using Scottish Health Behaviours in School-aged Children Survey data, exploratory and confirmatory factor analysis were conducted to derive measures of adolescents' perceptions of their local neighbourhood and test for urban/rural invariance. Multilevel models were used to estimate ecometric properties and generate neighbourhood scores. These measures were then used in models to explore associations between various physical and social conditions of the local area with adolescent alcohol use and drinking motivations. Path analysis explored for potential mediating effects of drinking motivations on drinking outcomes.

The findings from this thesis indicate that where adolescents live is associated with their alcohol use behaviours and motivations. Neighbourhood social cohesion, urban/rural status and neighbourhood deprivation may give rise to inequalities in alcohol use. Evidence of drinking to cope as a mediator in the relationship between deprivation and weekly alcohol use suggests that drinking as a coping strategy differs by geographic subgroups. Findings support that targeted prevention and intervention strategies are needed to reduce inequalities. Programmes developed to encourage coping skills should be implemented, principally in deprived neighbourhoods and accessible small-towns. Future research is needed to develop and assess strategies to reduce inequalities in adolescent drinking in Scotland.

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Statement on collaborations

All aspects of the work described in this thesis were conceived, led, and managed by me. I conducted all statistical analysis, formulated the research proposal, and wrote each Chapter and all manuscripts stemming from this work.

My supervisors Professor Candace Currie and Dr. Jo Inchley assisted with conceptualisation, interpretation of results, edited drafts and appraised all manuscripts that were written from work presented in this thesis.

Dr. Alan Marshall, provided statistical advice and appraised the manuscript that was written from work present in Chapter 8.

Dr. Niamh Shortt, provided data on alcohol outlet density and assisted with conceptualisation and interpretation of alcohol outlet measures and appraised the manuscript from work in Chapter 8.

Dr. Gerry Humphris provided statistical advice and appraised the manuscript that was written from work presented in Chapter 7.

Dr. Anna Gavine was a second screener, reviewed the systematic review protocol and appraised the manuscript that was written from work presented in Chapter 4.

Ms. Dorothy Currie provided statistical advice throughout this PhD.

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Declarations

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I, Gina Martin, do hereby certify that this thesis, submitted for the degree of PhD, which is approximately 60,000 words in length, has been written by me, and that it is the record of work carried out by me, or principally by myself in collaboration with others as acknowledged, and that it has not been submitted in any previous application for any degree.

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List of abbreviations

- **ADF** - Asymptotically Distribution-Free
- **AOD** - Alcohol Outlet Density
- **ANOVA** - Analysis of Variance
- **CFA** - Confirmatory Factor Analysis
- **CFI** - Comparative Fit Index
- **COSMIN** - COnsensus-based Standards from the selection of health status Measurement INstruments
- **CTC** - Communities that Care
- **DIC** - Deviance Information Criteria
- **DMQ-R** - Drinking Motives Questionnaire - Revised
- **EFA** - Exploratory Factor Analysis
- **GFI** - Goodness of Fit Index
- **HBSC** - Health Behaviours in School-aged Children
- **IDW** - Inverse Distance Weighting
- **IRT** - Item Response Theory
- **ITN** - Integrated Transport Network
- **KDE** - Kernel Density Estimation
- **MAUP** - Modifiable Areal Unit Problem
- **MCMC** - Markov Chain Monte Carlo
- **ML** - Maximum Likelihood

- **NSPL** National Statistics Postcode Look-up
- **OA** - Output Area
- **RMSEA** - Root Mean Square Error of Approximation
- **SALSUS** - Scottish Schools Adolescent Lifestyle and Substance Use Survey
- **SDH** - Social Determinants of Health
- **SE** - Standard Error
- **TLI** - Tucker-Lewis Index
- **US** - United States of America
- **UTREC** - University Teaching and Research Ethics Committee
- **WHO** - World Health Organization
- **WLSMV** - Weighted Least Squares Means and Variance

List of Figures

List of Tables

Contents

Chapter 1

Thesis overview

1.1 Thesis motivation

Studies examining neighbourhood level social factors and their potential associations with alcohol use tend to focus on socio-economic factors (such as deprivation). Several reviews of these studies found mixed results (Bryden et al., 2013; Sampson et al., 2002). When a positive relationship is found between neighbourhood deprivation and alcohol use, the mechanisms underlying the relationship are often hypothesised to be due to social processes, such as low neighbourhood social cohesion or social control, and high neighbourhood disorder or disorganisation (Neutens et al., 2013; Schulz et al., 2013; Tanner-Smith, 2012). In light of the mixed findings of studies examining the relationship between neighbourhood socio-economic deprivation and adolescent alcohol use, it has been suggested that the next step should be to focus attention on the impact of neighbourhood social factors (Fagan et al., 2013).

In Bryden et al.'s (2013) review of the influence of neighbourhood factors on drinking outcomes, they found only five studies that examined the association of neighbourhood social environmental conditions with drinking outcomes among adolescents. These studies had differing results. Additionally, various measurements of the social environment

were used even when similar constructs were under study. Moreover, some constructs were measured at the neighbourhood level, while others were individuals' perceptions of the neighbourhood. A review by Jackson et al. (2014) focused on the neighbourhood level and also found mixed results in terms of the association between the neighbourhood social environment and adolescent alcohol use. Again, there was much heterogeneity between measures of both the social environment (i.e., neighbourhood disorder was measured by crime in one study and perceived abandoned buildings in another) and drinking outcomes. It is clear that only a small number of studies have explored relationships of the social environment and adolescent alcohol use outcomes and more research is needed. Additionally, no previous study has examined associations between neighbourhood characteristics and why adolescents drink. Drinking motivations are key to understanding the functions that alcohol serves to young people. Exploring the relationships between neighbourhood factors and alcohol use can aid in developing and targeting intervention and prevention strategies (Bryden et al., 2013).

1.2 Summary and gaps addressed in this thesis

Several knowledge gaps exist in understanding the relationship between neighbourhood conditions and adolescent drinking behaviours. This research will seek to address four main issues and gaps in the literature: 1) the neighbourhood social environment suffers from a lack of consistency in terms of conceptualisation and measurement, 2) the role of neighbourhood environmental social conditions in adolescent alcohol use has not been explored in Scotland, 3) urban-to-rural inequalities in adolescent drinking are often not explored, and 4) potential relationships between neighbourhood conditions and adolescent drinking motives are lacking.

1.2.1 Conceptualising and measuring the neighbourhood social environment

The research undertaken in this PhD seeks to expand knowledge of neighbourhood social conditions and adolescent alcohol use. However, a lack of understanding on how the neighbourhood social environment is conceptualised and measured presents a barrier in moving forward. Accordingly, a systematic review was undertaken to identify studies that measure the neighbourhood social environment among adolescents and assess their methodological quality (Chapter 4). This was deemed an important step due to the complexity of defining and understanding the neighbourhood social environment. Further complicating the issue is the dearth of studies validating neighbourhood social environment measures among adolescents (Åslund and Nilsson, 2013). There is a need to examine the reliability and internal validity of these constructs within studies that utilize them (Harpham, 2008) and extend these measures beyond individual perceptions to collective neighbourhood constructs (Aminzadeh et al., 2013).

1.2.2 Neighbourhood social environmental conditions and adolescent alcohol use in Scotland

The role of neighbourhood social conditions which adolescents are exposed in adolescent alcohol use is an emerging area of study. Previous work has been conducted in many US contexts (Jackson et al., 2014) and more recently in New Zealand (Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016) and Taiwan (Chen et al., 2016). This work is the first to explore the neighbourhood level social conditions, beyond socio-economics, for adolescents in Scotland.

1.2.3 Urban/rural inequalities in adolescent drinking

Living in an urban or rural context has been associated with drinking behaviours. However, results differ between studies that use a dichotomous urban/rural classification

versus an urban-to-rural continuum (Dixon and Chartier, 2016). There are a dearth of studies that examine urban-to-rural differences in alcohol use among adolescents (Chan et al., 2016). To examine this using various classifications of urban/rurality, as suggested by Dixon and Chartier (2016), a sampling strategy that includes adolescents living in various urban and rural locational conditions is needed. Accordingly, this research will utilise a data set which includes an oversample of rural adolescents.

1.2.4 Neighbourhoods and drinking motives

Drinking motives research is based on the assumption that drinking behaviour is motivated by various needs and serves different functions to the individual (Kuntsche et al., 2005). Drinking motives are often regarded as the final pathway to alcohol use which link to various drinking patterns and may mediate more distal influences (Kuntsche et al., 2005). However, currently there are no studies that examine whether adolescent drinking motives vary across neighbourhoods. Exploring the associations of neighbourhood conditions with drinking motives has been identified as an important area for future work (Karriker-Jaffe et al., 2016). This work will examine for associations between neighbourhood characteristics and adolescent drinking motives. Additionally, the potential for drinking motives to mediate the relationship between neighbourhoods and alcohol use is explored.

1.3 Key concepts

This thesis draws on several concepts, which underpin the development of the study, design of the methods, and interpretations of the findings in this body of research. These concepts are briefly outlined. This section does not provide an exhaustive examination of these concepts as the body of literature on each is vast; however the ideas are introduced and where appropriate it is highlighted how the concepts relate to the research presented in this thesis.

Additionally, this research draws largely on a social positivist philosophical approach, drawing on measured data and statistical relationships to understand the issues under investigation. A limitation of this approach is that it describes more than explains (Gatrell and Elliott, 2009). However, in the discussion of findings structuralist ideals are also incorporated. Structuralism considers that political and economic systems underlie observed relationships. By combining these different viewpoints in interpreting the findings of this research, it is hoped that the complexity of adolescent drinking is acknowledged. This is not to take the position that other approaches are less valuable than the ones utilised in this thesis; but rather to point out the underlying philosophical stance of this work, to provide a lens through which to reflect on the conceptual decisions made, and to understand the limits of this research.

1.3.1 Adolescence

Adolescence is an important period of change in the human life course. During this period a wide range of psychological and biological changes occur, corresponding with the increased importance of social influences (Viner et al., 2012). Adolescence is generally thought to begin around the onset of puberty. During puberty rapid physical growth and the onset of sexual maturity occurs. Additionally, during this phase strong emotional influences can affect self-regulation and decision-making (Dahl, 2008). Generally, adolescence is thought to be complete when adult identity and behaviour are fully formed (Sacks, 2003).

Given that adolescence represents both a biological and cultural concept, delineating the ages in which adolescence occurs is not easy. The World Health Organisation (WHO) has defined adolescence from the age of 10 through to 19 (World Health Organization, 2017). The cut-off of 19 represents an age when most individuals have completed secondary school. However, Sawyer et al. (2018) argue that these cut-offs do not fit with contemporary notions of adolescence. The age of pubertal onset has been decreasing;

while traditional milestones that mark adulthood (i.e., marriage or purchasing a home) have been occurring later or not at all (Sawyer et al., 2018).

In Chapter 4, a cut-off of 10-19 was used in the systematic review of adolescent measures of the neighbourhood social environment. This was largely pragmatic as many studies were school-based and this allowed for greater comparability. For the purposes of the research presented in Chapters 7 through 9 only data collected from pupils in their fourth year of secondary school are utilised. This is due to data availability, which is discussed in more detail in Chapter 6. Despite these restricted ages, the work in this thesis recognises that adolescence, in its broadest sense, is a time of major biological, psychological, and social change, and that all age ranges included in this thesis fall within this stage of the life course.

1.3.2 Social epidemiology

In its most general form, epidemiology is the study of the distribution, incidence and aetiology of health and disease in populations (Green et al., 2011). Social epidemiology is further defined as "the branch of epidemiology that studies the social distribution and social determinants of states of health" (Berkman and Kawachi, 2000, p.6). The idea that the social environments which individuals are exposed to impact their health is not new and has been posited in several disciplines, such as sociology and political science. A well known early example is the work of French sociologist Durkheim (1897), who found relationships between markers of social integration and suicide rates.

Despite the long history of examining health through a social lens, the idea of social epidemiology as a sub-discipline of epidemiology is relatively new (Honjo, 2004). A vital idea within social epidemiology is that health-related behaviours are socially influenced and are not solely the consequence of individual choice. Further, choice may be constrained by the environment that a person is exposed to. Berkman and Kawachi (2000) state that:

> "The social environment influences behaviour by (1) shaping norms, (2) enforcing patterns of social control (which may be health-promoting or health-damaging), (3) providing or not providing environmental opportunities to engage in certain behaviours, and (4) reducing or producing stress for which certain behaviours may be an effective coping strategy, at least in the short term." (p.7)

These pathways through which the social environment can influence human behaviour have clear relevance to alcohol use. Drinking behaviours are heavily patterned by social and cultural norms; there are multiple enforcing agents that act to control behaviours relating to substance use; availability of substances is determined by the social and structural environment; and, alcohol can be utilised to self-medicate or cope with stressful situations. Given this it is not surprising that the sub-discipline of the 'social epidemiology of substance use' has emerged. This term defines the field that explores the social conditions that impact substance use behaviour within human populations (Galea et al., 2004). Accordingly, this represents a relevant domain in which the research presented in this thesis is situated.

1.3.3 Social determinants of health

Often social epidemiology focuses on the social determinants of health (SDH). These are defined as the conditions of society that impact health, and the pathways through which this occurs (Krieger, 2001). These conditions are often more distal or 'upstream' than the individual risk and protective factors that influence people's health (Viner et al., 2012). Often the SDH are thought of as 'the causes of the causes' of health (Marmot, 2005), such as safe housing and access to education.

Alcohol use is causally associated with mortality and morbidity in human populations (Room et al., 2005). From a SDH perspective, understanding the social conditions that underlie alcohol consumption is therefore crucial in developing appropriate public

health policies and interventions.

1.3.4 Neighbourhood effects

In recent decades, a distinct body of research has emerged examining neighbourhood effects. Neighbourhood effects can best be defined as: the conditions of the neighbourhoods that impact on residents' health outcomes over and above their individual characteristics (Van Ham et al., 2012). Generally, when significant effects are found, they tend to be small (Lupton, 2003); this is likely due to the distal nature of neighbourhood characteristics.

Adolescence is a time of increased autonomy when young people spend more time outside of the home unsupervised; this leads to increasing significance of the conditions of the neighbourhoods in the lives of adolescents (Viner et al., 2012); therefore, exploring the role of neighbourhoods during adolescence is important in understanding the health and well-being of young people.

Several common issues arise when exploring neighbourhood effects. One challenge is the definition of neighbourhood boundaries. The spatial scale that is selected for the study may have implications for the results. This is known as the modifiable areal unit problem (MAUP) (Gatrell and Elliott, 2009). Additionally, the delineation of what constitutes a neighbourhood may vary from person to person. Activity spaces based on geographical positioning systems allow for neighbourhood exposure to be measured by routine movement (Mennis et al., 2018) and represent an exciting area for future work.

Selection bias is also a concern in studies of neighbourhood effects. This is where, individuals selectively sort themselves into neighbourhoods based on place characteristics (Lupton, 2003). Parents may select certain locales based on characteristics they believe will benefit their child; however, adolescents are not likely to actively select the neighbourhoods they reside in. Therefore selection bias is of less concern in studies of children and youth (Morris et al., 2018).

1.3.5 Health inequalities and inequities

Health inequalities are measurable differences in health between individuals or groups, while inequities are differences that are deemed unjust. From a SDH perspective, health inequalities that stem from uneven circumstances are unfair and therefore represent inequities (Kawachi et al., 2002).

Inequalities can be based on individual characteristics (such as race or gender) or environmental spheres (such as family or school). Environmental inequalities may also be place-based (such as neighbourhood or country of residence). Explanations for geographic inequalities in health are viewed as compositional or contextual. Compositional explanations attribute spatial patterns to shared characteristics of residents. Contextual explanations attribute patterns to characteristics of the locality (Bernard et al., 2007). However, neighbourhoods are dynamic, and compositional and contextual factors may influence each other. Therefore, delineating between the compositional and contextual may result in false distinctions.

Alcohol consumption represents a health-related behaviour in that alcohol is casually related to a wide-variety of health outcomes. Health-behaviours are often socially patterned; different groups are more likely to engage in these potentially health damaging behaviours giving rise to inequalities and inequities in acute and chronic conditions (Gatrell and Elliott, 2009). Public health strategies are often concerned with reducing inequalities by focusing on those who are at greater risk of reduced health and well-being.

1.4 Thesis objectives and structure

1.4.1 Aims and objectives

This PhD thesis contributes to the evidence base by examining the role of neighbourhood characteristics in predicting adolescent alcohol use behaviours and motivations,

utilising quantitative methods and existing survey data. Additionally, conceptualisations of the neighbourhood social environment are explored. It builds on past studies by including, not only measures of socioeconomic deprivation and alcohol availability, but also neighbourhood social characteristics. Moreover, this research examines the potential influence of urban/rural residential locations on adolescent alcohol use. This research also goes beyond examining consumption as an outcome and will also examine motivations to drink.

Objectives addressed in this thesis:

1. To assess the methodological quality of studies reporting on measures of the neighbourhood social environment.

2. To critically review and compare how these measures are conceptualised and operationalised.

3. To make recommendations for future use of neighbourhood social environmental measures in studies of adolescents.

4. To determine whether adolescent alcohol use behaviours and drinking motives vary by neighbourhood, in a Scottish sample.

5. To determine which neighbourhood characteristics are associated with adolescent alcohol use behaviours and drinking motives, in a Scottish sample.

6. To examine if adolescent drinking motivations are a potential mediator in the relationship between neighbourhood characteristics and alcohol use.

1.4.2 Thesis structure

This thesis presents an introduction to the role of adolescent alcohol use as a public health issue and looks at contemporary trends and patterns globally and nationally in

Chapter 2. Chapter 3 presents an overview of neighbourhood characteristics that may influence adolescent alcohol consumption in Scotland. An outline of the conceptual frameworks that will guide this research is presented in Chapter 5.

As the quality of measures used in modelling adolescent alcohol use are crucial to research, and given the ambiguity surrounding measures of the neighbourhood social environment, a systematic review of survey measures used to measure adolescent neighbourhood social environment was undertaken. The systematic review formed the foundation for a measurement validation which was completed prior to use in the models. This work is described in Chapter 4 and includes content from an article published in SSM- Population Health (Martin, Gavine, Inchley and Currie, 2017).

The data and statistical approaches used in this research are described in detail in Chapter 6. Prior to conducting analysis investigating associations of the neighbourhood social environment with adolescent drinking outcomes, the psychometric and ecometric properties of the neighbourhood social environment were explored. This is presented in Chapter 7 and includes content from an article published in Population Health Metrics (Martin, Inchley, Humphris and Currie, 2017).

Chapter 8 examines associations of the neighbourhood conditions where adolescents' live and their alcohol use. This work includes content from an article that is under review for the International Journal of Public Health. Chapter 9 expands on this work by exploring the relationships between neighbourhood characteristics and adolescent drinking motives. Based on these findings and the results from Chapter 8, the potential role of drinking motives as a mediator between neighbourhood factors and drinking behaviours is investigated.

Finally, Chapter 10 brings together the findings on how adolescent drinking is influenced by neighbourhood characteristics and considers the research and public health implications of these findings. Strengths, limitations and future research directions are also discussed.

Chapter 2

Adolescent alcohol use

2.1 Adolescent alcohol use: A public health perspective

Adolescent alcohol consumption has long been established as a public health concern (Jones et al., 2012; Marshall, 2014). Since the beginning of recorded history people have consumed alcohol; along with this has been a widespread interest in the health and social issues that stem from consumption (Room et al., 2005). Concerns regarding the impact of alcohol on young people have been particularly salient. This has resulted in policies that focus on children and adolescents, such as minimum legal ages for purchasing alcohol. The English 1886 Intoxicating Liquors (Sale to Children) Act restricted alcohol sales to any person under the age of 13. In 1923, this was amended to 18 as it was successfully argued in parliament that children were at greater risk of damage from the effects of alcohol.

Because initiation into alcohol use often occurs in adolescence, this life stage has been identified as a crucial period to reduce harms from drinking (Hawks et al., 2002; Kuntsche et al., 2005; Tanner-Smith, 2012). In Scotland, 28 percent of adolescents have tried alcohol by the age of thirteen (The Scottish Government, 2016*b*). This is of particular concern given that this is a sensitive period for cognitive maturation. Recent

studies suggest that heavy alcohol use in adolescence may disrupt brain development (Newbury-Birch et al., 2009; Welch et al., 2013). Most notable is that heavy alcohol consumption among adolescents is associated with reduced volume in the hippocampus; the area of the brain that is crucial for learning and forming memories (De Bellis et al., 2000). Consequently, it is important to understand the emerging trends and risk factors associated with adolescent alcohol use in order to better inform the development of intervention and prevention strategies for those in this sensitive phase of life (Caria et al., 2011; Sznitman et al., 2013; Tanner-Smith, 2012).

Within public health research there is a focus on the acute harms that may result from alcohol use among adolescents. This is not surprising, given that acute harms are more likely than chronic conditions in this age group due to young people's relatively short duration of lifetime use. Acute harms include incidents such as, alcohol poisoning, vehicular accidents, assaults, and injuries (Newbury-Birch et al., 2009; Toumbourou et al., 2007; Kuntsche et al., 2013; Hall et al., 2016). A study in Victoria, Australia, found that one in five drinkers aged 16-17 self-report an alcohol-related injury and one in ten report a sexual experience that they regret due to their drinking (Bonomo et al., 2001). Adolescents' lack of experience with alcohol may be a factor in the increased risk of harms because they are not able to understand the quantity needed to achieve their desired effect (Hall et al., 2016). However, the impact on adolescent health may extend beyond event level harms as many issues such as sleep disturbance and headaches are associated with alcohol misuse (Newbury-Birch et al., 2009).

Alcohol use behaviours in adolescents may also be linked to chronic conditions, through increased consumption later in life. There is evidence that alcohol use in adolescence is associated with binge drinking in early adulthood (Jefferis et al., 2005; Viner and Taylor, 2007). Moreover, risky adolescent drinking patterns are associated with increased risk of alcohol abuse and dependence in adulthood (Jones et al., 2012; McCambridge et al., 2011). Trend data from Glasgow have shown that mortality stemming

from alcohol-related chronic conditions is occurring among younger individuals, especially women (Shipton et al., 2013). This is a worrying trend as several years of heavy drinking is a precursor to alcohol-related conditions, such as liver disease (Newbury-Birch et al., 2009). A causal relationship is present with alcohol and up to 60 conditions, such as many cancers and depression (Room et al., 2005). The evidence suggests that although chronic conditions are less likely to be seen in adolescents, early interventions that aim to reduce drinking among adolescents are needed to limit chronic harms later in life.

Although there are many negative impacts of drinking alcohol it is important to acknowledge that some benefits of alcohol use have been reported by adolescents, examples include increased confidence in relating to peers and enhanced sociability (Engels and ter Bogt, 2001; Hoel et al., 2004; Newbury-Birch et al., 2009). However, due to the increased risk for many negative health impacts (both psychosomatic and physical), compared to the relatively fewer positive impacts (Hoel et al., 2004), the need to understand adolescent alcohol use as a contemporary public health concern is evident. That adolescent alcohol use is prevalent, and serves a function to young people, despite its associated risks, means it is likely that many adolescents will use alcohol at some point. Adolescence is a time when risk-taking and experimentation often occur. Therefore, harm-reduction strategies that focus on reducing health impacts associated with alcohol use may be more realistic than strictly abstinence-based approaches (Leslie, 2008). Additionally, prevention strategies that emphasise well-being by improving various individual and contextual conditions have shown some evidence of efficacy (Toumbourou et al., 2007).

Public health strategies aimed at adolescent alcohol use can be classified as universal, directed at whole populations, or selective, targeting groups at increased average risk. An alternative categorisation of approaches are: primary, aiming to reduce new cases, secondary, seeks to limit harm in early stages, and tertiary dealing with long-term

consequences (Toumbourou et al., 2007). These classifications can be applied to both harm-reduction and developmental prevention strategies.

2.2 Patterns and trends in adolescent alcohol use

Alcohol use, as well as other risky behaviours, is on the decline within the adolescent age group in more Westernised countries (de Looze et al., 2015; Inchley et al., 2016). By 2014, most Western European countries saw a decline in weekly alcohol use (Inchley et al., 2016). In Australia, there was an increase in alcohol abstention from 32.9 percent in 2001 to 50.2 percent in 2010, among 14 to 17 year olds, and this increase in non-drinking occurred consistently across demographic, socio-economic and urban/rural groups (Livingston, 2014). From a public health perspective this is encouraging although there are still some worrying trends. Contrary to Livingston (2014), a New Zealand study of urban adolescents found that the decline in drinking occasions, from 2007 to 2012, was not evenly distributed across the population with young females of low household affluence, and reduced neighbourhood socio-economic status seeing an increase in quantities of alcohol consumed (Jackson, Denny, Sheridan, Zhao and Ameratunga, 2016). These findings show that despite overall decreases in alcohol consumption, inequalities in drinking trends may exist based on some demographic or regional characteristics.

In Scotland, high levels of alcohol use among adolescents has been identified as a public health priority (Varney and Guest, 2002; Young et al., 2012). Although adolescent alcohol use is common among many European and North American countries, Scottish adolescents tend to report higher rates than many other nations (Kloep et al., 2001). For example, in 2010 Scotland's 15 year olds rank 7th out of 38 countries in Europe and Canada for having been drunk at least twice in their lifetime (Currie et al., 2012) while in 2014 Scotland ranked 5th out of 42 countries (Inchley et al., 2016). While rates of weekly drinking among 15 year olds in Scotland have decreased in the last couple of

decades (from 30 percent to 17 percent for boys and 26 percent to 11 percent for girl, from 1990 to 2014), drunkenness has not declined at the same rate especially among girls (Currie et al., 2015). In 2014, 34 percent of girls and 33 percent of boys reported having been drunk twice or more in their lifetime (Inchley et al., 2016). Additionally, based on an audit of Scottish emergency rooms, it is estimated that fifteen individuals per day, aged 17 or younger are admitted to Scottish hospitals intoxicated (Christie, 2008; NHS Quality Improvement Scotland, 2008); this equates to approximately 1,707 hospital admissions per 100,000 of the population aged 13-17, annually. A potential explanation for the relatively high rates of adolescent alcohol consumption in Scotland may be the perceived importance of drinking as part of Scottish culture (Bromley and Ormston, 2005). However, how culture has influenced Scottish adolescents in the past decade is unknown. It is clear that, despite declining trends in alcohol consumption, there is still much to understand about the predictors of adolescent drinking across Scotland.

2.3 Risk factors for adolescent alcohol use

Alcohol use does not occur uniformly within the adolescent population. Adolescents are initiated into alcohol at different ages, typically drink at varying volumes and frequencies, and drink for different reasons. Understanding the risk factors that predict these differences represents a wide focus for research. Broadly, predictors can be categorised as individual, family, peer, school and neighbourhood. Additionally, macro-level predictors such as national legislation, fiscal measures, and regional cultural norms may have an impact on adolescent drinking levels. These represent different domains of influence on young people's alcohol use.

Individual predictors are characteristics of the person and can include sex, gender, age, sexuality (Talley et al., 2014), ethnicity (Fagan et al., 2015), and psychological traits, for instance sensation seeking (Stautz and Cooper, 2013). Previous research has

found males typically drink at higher frequency and quantity than females, although this gap is shrinking, and that older adolescents are more likely to engage in drinking (Inchley et al., 2016). Adolescents who identify as a sexual minority exhibit riskier drinking behaviours than heterosexual young people (Talley et al., 2014). Additionally, specific personality traits have been linked to alcohol use; the most notable are indicators of impulsiveness (Stautz and Cooper, 2013).

Beyond differences between individuals, family characteristics are also important and studies have shown that adolescents from single parent families are more likely to engage in higher rates of drinking (Miller, 1997; Ledoux et al., 2002; Donath et al., 2012). Relational aspects within the family are also associated with alcohol consumption. Parental closeness, for example, has been found to be protective against lifetime use of alcohol, among rural adolescents (De Haan et al., 2010). Interestingly, affluence within the family has not consistently been found to be associated with adolescent alcohol use; this suggests that it is the relational and monitoring aspects of the family that have greater influence on adolescent drinking behaviours (Inchley et al., 2016).

Peers have also been found to play a strong role in alcohol use. Many studies have confirmed that peer substance use is "one of the most solid predictors" of alcohol use throughout adolescence (Tomczyk et al., 2015, p. 120). Binge drinking is positively associated with the number of friends an adolescent has (Donath et al., 2012), and peer substance use has been found to be associated with any alcohol use among adolescents (Fagan et al., 2015). Similarly, among young people residing in rural areas, perceptions of peers drinking was associated with lifetime use of alcohol but not past month use (De Haan et al., 2010). Adolescents who report that most of their peers drink are more likely to engage in drinking themselves. However, it is difficult to know the direction of this relationship as young people who drink may seek out similar peers.

School may also play a role in adolescent drinking behaviours as previous studies have highlighted that alcohol use rates vary across schools (Andersen et al., 2007; Mrug

et al., 2010; Ennett et al., 1997). School commitment and integration have been shown to protect against binge drinking; while aggressive behaviours of teachers has been found to be associated with binge drinking (Donath et al., 2012). Additionally, social norms in schools and school bonding have been shown to be associated with adolescent drinking behaviours (Tomczyk et al., 2015). Despite this, school-based intervention approaches have not been shown to be consistently effective (Inchley et al., 2016; Room et al., 2005). This may be because adolescents reject programs that are seen as condemnatory (Leslie, 2008).

Overall, there is a long research history in studying individual, family, peer, and school associations with adolescent alcohol use. However, a domain considered less often than the before mentioned factors is the neighbourhood. For this reason, the influence of neighbourhood characteristics on adolescent drinking, which is the focus of this dissertation, will be introduced in greater depth in Chapter 3.

2.4 Summary

It is clear that many acute harms are associated with adolescent alcohol use and that chronic conditions later in life are linked to alcohol use behaviours during this developmental phase. Therefore, understanding the predictors of adolescent alcohol use is an important area of public health inquiry. In Scotland, adolescent drinking has been declining in recent years, but Scottish adolescents are more likely to engage in alcohol use behaviours than their peers in several other European and North American countries. This highlights the particular importance of understanding predictors of adolescent drinking in the Scottish context.

Chapter 3

Neighbourhoods and adolescent alcohol use: a narrative review

3.1 Introduction

Many risk factors have been identified in predicting adolescent alcohol use; however, an often overlooked dimension of inquiry is whether the neighbourhood that adolescents reside in is associated with their drinking behaviour and if so what characteristics might explain this. While little research has been conducted on the topic, the few studies that exist suggest that neighbourhood may be a factor in influencing alcohol use as significant neighbourhood variation is present for adolescent drinking outcomes. These studies have largely been conducted in the United States and New Zealand (Jonkman et al., 2012; Fagan et al., 2015; Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016; Brenner et al., 2011; Fagan et al., 2013; Ennett et al., 2008; De Haan et al., 2010). This variation suggests that neighbourhood characteristics might contribute to alcohol use among adolescents (Slutske et al., 2016). The collective neighbourhood characteristics that influence alcohol consumption are referred to as the "alcohol environment" (Theall, Scribner, Cohen, Bluthenthal, Schonlau and Farley, 2009; Theall,

Scribner, Cohen, Bluthenthal, Schonlau, Lynch and Farley, 2009) Gaining a better understanding of any neighbourhood characteristics associated with variations in adolescent alcohol use allows for a more upstream approach to prevention and intervention strategies (Jackson et al., 2014). Further, understanding the neighbourhood factors that influence these differences can aid in gaining a better understanding of the aetiology of adolescent drinking behaviours (Yen and Syme, 1999; Breen et al., 2014; Jackson et al., 2014; Jonkman et al., 2012; Castillo et al., 2017).

Three recent systematic reviews have been conducted that look at the associations between neighbourhood and adolescent drinking behaviours (Jackson et al., 2014; Bryden et al., 2012, 2013). It is not intended to duplicate these reviews in this Chapter but rather to take a narrative approach to exploring the findings of these reviews and discuss results of more recently published research. Bryden et al. (2012) presents a review of neighbourhood predictors of alcohol availability and marketing on drinking outcomes. Bryden et al. (2013) examines neighbourhood social factors (which may be at the individual or neighbourhood level) and highlights research undertaken on adolescent populations. The Jackson et al. (2014) review focuses on multilevel-modelling of neighbourhood social and socio-demographic influences on adolescent alcohol use. Generally, these reviews found that studies examining alcohol outlet density and neighbourhood socio-economic status are the most prevalent in the literature. A smaller number of studies also exist that examine the role of the neighbourhood social environment and neighbourhood level social norms. Other research has also identified urban/rurality as an important characteristic of the alcohol environment (Slutske et al., 2016; Dixon and Chartier, 2016). Accordingly, this chapter will outline contemporary evidence of the role of neighbourhood level risk and protective factors associated with adolescent alcohol use.

3.2 Risk and protective factors

3.2.1 Commercial alcohol availability

In the general population, the most extensively studied contributor to the alcohol environment is commercial availability (Slutske et al., 2016). In their review Bryden et al. (2012) found eight studies that examined adolescent alcohol use in relation to commercial alcohol availability. The majority of studies found some association with adolescent drinking behaviours; however, results often varied by the drinking outcome and availability measure used in analyses (i.e., Milam et al., 2013; Paschall et al., 2012). Additionally, the majority of these studies were conducted in the US.

Since Bryden et al.'s (2012) review a representative study of Australian youth showed that drinking behaviours of younger adolescents (aged 12-14) were sensitive to outlet density while the behaviours of older adolescents were not (Rowland et al., 2014). Azar et al. (2016) found differential effects of alcohol outlet density in Australia by urban/rural status, with urban adolescents having stronger associations. A Scottish study of adolescents from Glasgow examined the relationship between weekly alcohol use and commercial alcohol availability and found proximity to off-trade outlets (sites where alcohol is purchased to be consumed elsewhere) was positively associated (non-linearly) with alcohol use; however density was not. This relationship was only present at shorter distances than found in previous research of adults (Young et al., 2012), which supports the hypothesis that adolescent health behaviours are influenced by a more limited geographic area due to restricted mobility (Åslund and Nilsson, 2013; Tanner-Smith, 2012). They also found no association with on-trade outlets (sites where alcohol is purchased and consumed on-site). In Taiwan, exposure to betel nut kiosks (a largely unregulated alcohol source) was associated with alcohol use in adolescents; on-trade and off-trade consumption availability were not (Chen et al., 2016). These examples indicate that the effect of commercial alcohol availability may vary by measurement of commercial

alcohol availability, the population under study (i.e., specific age groups or regions), and drinking outcome examined.

Despite the inconsistent findings, commercial alcohol availability may represent an important covariate in studies of other factors of the neighbourhood environment and adolescent drinking behaviours (Vinther-Larsen et al., 2013). For instance, there is strong evidence that alcohol outlets are concentrated in specific types of areas, such as more deprived areas or areas with low social cohesion and high disorder (Theall, Scribner, Cohen, Bluthenthal, Schonlau and Farley, 2009; Huckle et al., 2008; Burton et al., 2017; Ayuka and Barnett, 2015). In Scotland inequalities in commercial alcohol availability have been found with higher density of outlets in areas of higher neighbourhood deprivation (Shortt et al., 2015); making this an important consideration in the Scottish context.

Overall, in light of disparities in past findings, more research is needed to gain a better understanding of the relationship between commercial alcohol availability and adolescent alcohol use. When designing studies and interpreting results, careful consideration should be given to the measure of commercial availability used. Additionally, context may be an important aspect in terms of research findings. It may be that studies with a higher proportion of urban adolescents will be more likely to find significant associations. Interactions between other neighbourhood conditions with commercial alcohol availability therefore warrant greater consideration.

3.2.2 Neighbourhood deprivation

Neighbourhood deprivation represents the level of material or economic disadvantage experienced within a defined geographic area. It is usually measured through multiple census indicators which form an index of deprivation. It has been hypothesised that material deprivation within the neighbourhood may lead to deterioration of neighbourhood conditions causing increased alcohol use in order to cope with the stress of living

in such an environment (Bloomfield and Stock, 2013). Neighbourhoods that experience deprivation are hypothesized to have low levels of social cohesion and integration, which is thought to increase problematic behaviour such as adolescent drinking (Jackson et al., 2014). Additionally an increase in collective perceptions of physical disorder may be present in more deprived areas (Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016) which may reduce positive social neighbourhood characteristics (Burchfield, 2009) and increase a need to cope. This is in-line with social disorganisation theory which will be discussed more in Chapter 5. A notable study of urban high school students in New Zealand found that neighbourhood disadvantage both directly and indirectly (through neighbourhood physical disorder and collective efficacy) influenced high quantity drinking among young adolescents, in the expected directions; while those aged sixteen and above saw indirect effects only (Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016).

Despite these theoretical links and some supporting evidence, studies that have examined relationships between adolescent alcohol consumption and neighbourhood deprivation have found varied results (Bryden et al., 2012; Jackson et al., 2014). Some studies have found increased risk of alcohol consumption for those living in deprived areas while some have found higher levels of consumption among those living in more affluent areas (i.e., Maimon and Browning, 2012; Snedker et al., 2009; Snedker and Herting, 2008). A study in Taiwan, for example, found residents of districts with lower levels of disadvantage were more likely to report lifetime consumption (Chen et al., 2016). These findings are similar to a study in Oslo, which found that adolescents in the more affluent areas of the city reported more frequent alcohol consumption and higher levels of intoxication. Interestingly, among those who did drink, more alcohol-related problems were found among those in the less affluent areas of the city (Pedersen et al., 2015). Other studies have found no relationship among the population as a whole, but significant relationships have been identified among specific subgroups, such

as African Americans (i.e., Fagan et al., 2013; Kling et al., 2007; Trim and Chassin, 2008; Jensen et al., 2017). Moreover, the effect of individual personality characteristics on drinking have been found to be influenced by neighbourhood deprivation. A study of adolescents in Arizona found that neighbourhood disadvantage did not have a direct effect on alcohol initiation but a significant interaction was found between neighbourhood disadvantage and sensation seeking, where a stronger relationship is found in more advantaged neighbourhoods (Jensen et al., 2017).

The mixed findings may be due to variations in measures of alcohol consumption (i.e., quantity versus frequency), as proposed by Vinther-Larsen et al. (2013) or differences in control variables and model specification. Two studies in New Zealand found that results differed depending on drinking outcome measured or that in some cases the relationship was non-linear (Vinther-Larsen et al., 2013; Huckle et al., 2008). Additionally differences may be due to contextual differences between study sites (i.e., general population versus urban sites). Further, neighbourhoods experiencing deprivation may also have increased commercial availability to alcohol; both may influence consumption.

To better understand the role that neighbourhood deprivation may play in adolescent alcohol consumption, studies that are carefully designed to examine potential underlying mechanisms are needed.

3.2.3 Neighbourhood social norms

It has been theorised that social influences, such as the behavioural norms of a neighbourhood, may be more powerful than material deprivation in predicting health behaviours (Tobler et al., 2009). Moreover, it has been posited that if youth alcohol use becomes normative and enters mainstream society, young people who are "well-adjusted" as well as those who are "risky" will increasingly engage in use (Sznitman et al., 2013). In this scenario, areas with higher prevalence of use would see a weaker relationship between risk factors and alcohol use, than areas with lower prevalence (Sznitman et al.,

2013). Despite this, many studies have examined peer norms but fewer have examined neighbourhood norms. Neighbourhood social norms have been measured in many ways including, adult or peer tolerance or acceptance of drinking within a neighbourhood, or adolescent or adult drinking rates (Bryden et al., 2013; Jackson et al., 2014). Bryden et al.'s review (2013) found only two studies that examined neighbourhood social norms and adolescent drinking. Jackson et al.'s review (2014) found three studies that examined neighbourhood attitudes towards drinking and seven studies that examined neighbourhood-level alcohol use in terms of adolescent drinking. The results showed that neighbourhood norms were generally predictive of some drinking behaviours in adolescents; however, this varied by drinking outcome (Bryden et al., 2013; Jackson et al., 2014; Paschall et al., 2012, 2014). Since these reviews, little has been published in terms of neighbourhood social norms and adolescent drinking. One study found that a measure derived from Chicago adults of neighbourhood level intolerance of drug use did not predict adolescent lifetime use (Fagan et al., 2015). Differences in social norms could also play a part in urban/rural drinking disparities. Chan et al. (2016) found that parents drink alcohol in ways that are more likely to encourage adolescent drinking in rural than in urban areas in Australia. Due to the dearth of existing research in this area, further studies are needed to understand the influence of neighbourhood social norms on adolescent drinking.

3.2.4 Urban/rurality

Urban/rurality can be thought of as a higher level structural variable in that it is difficult to alter urban/rural status via community interventions (Jonkman et al., 2012). However, gaining more insight into the mechanisms that underlie the urban/rural inequality in adolescent drinking outcomes is an important area of future research which has received little attention to-date (Zhen-Duan and Taylor, 2014; Coomber et al., 2011). In order to better understand predictors of adolescent alcohol use, studies that are designed

to include both urban and rural participants are needed to allow for testing of direct, indirect, and moderating effects of urban/rurality (Wilson and Donnermeyer, 2006).

Multiple studies have found urban/rural variations in adolescent alcohol use (i.e., Coomber et al., 2011; Donath et al., 2011; Gutiérrez and Atienzo, 2011). Contemporary research undertaken in the US, Canada, Australia, Germany, Mexico and the Netherlands has consistently shown that adolescents residing in rural areas drink alcohol at higher rates than those in urban areas (Chan et al., 2016; Jiang et al., 2008, 2016; Coomber et al., 2011; Donath et al., 2011; Gutiérrez and Atienzo, 2011; Jonkman et al., 2012). A review of American studies looking at urban/rurality in relation to drinking outcomes found that alcohol use was typically highest among rural adolescents, but the opposite was found among adult populations; pointing to the need for a developmental perspective in understanding urban/rural drinking differences (Dixon and Chartier, 2016).

Moreover, it is important to note that urban/rurality can also be viewed as a continuum rather than a dichotomized variable. Dixon and Chartier (2016) suggest having multiple categories of urban/rurality because these areas do not perform in a uniform fashion in terms of drinking outcomes. For example small suburban towns that are accessible to large-cities face different circumstances than small towns that are inaccessible and metropolitan centres; this may translate into different drinking outcomes. Jiang et al. (2008) found that adolescents in medium-sized cities had higher rates of drunkenness and higher frequency of drinking that those in large- or small-sized cities.

Competing theories exist explaining urban/rural disparities. One theory assumes a lack of anonymity of residents in rural areas leads to less social disorganization and greater social control and social cohesion resulting in reduced adolescent alcohol consumption (Wilson and Donnermeyer, 2006). This is supported by the fact that urban/rural differences in social characteristics of the neighbourhood environment are well documented (Lo et al., 2013). However, as previously mentioned, recent research

does not support the notion that urban adolescents drink more than their rural counterparts. Alternatively two theories exist attributing higher rates of drinking among adolescents in rural areas: 1) those who live in rural areas lack accessibility to interesting leisure time activities; therefore leading them to engage in alcohol consumption due to a deficiency in alternative activities or 2) cultural differences lead to differing alcohol use patterns (Donath et al., 2012, 2011). Interactions between outlet density and urban/rurality have been found in a study of Australian adolescents, this could contribute to differences in adolescents drinking outcomes (Azar et al., 2016). However, given that urban adolescents were more influenced by density this is unlikely to be underlying the observed higher risk among rural adolescents.

Although many of the mechanisms related to urban/rural variations in adolescent alcohol use may, in part, relate to social and physical neighbourhood features, there are numerous other factors that may also influence urban/rural adolescent drinking disparities. Evidence suggests that alcohol plays a role in the identity of some rural communities, where drinking is part of a 'cultural capital' (Kloep et al., 2001). Some of this may be historic and relate specific economic industries which are linked to risky behaviours including substance use (Gay et al., 2018; OMullan et al., 2018; Valentine et al., 2008). Second, parental behaviour has been found to differ between urban and non-urban areas with non-urban parents more likely to drink in the home and more non-urban adolescents having their first alcohol supplied by parents (Chan et al., 2016). Third, a sense of isolation and exclusion may leave rural adolescents more vulnerable to risky behaviours than their urban peers (Valentine et al., 2008). Alternatively, the drinking spaces of the night-time economy (i.e., clubs) have been linked to the idea of urban life (Jayne et al., 2008). Moreover, the perceptions of the drinking behaviours of adolescents are influenced by urban/rural status; this is highlighted by (Jayne et al., 2008) who state that "drinking among young people is framed as a 'problem' – differently in urban and rural areas" (p. 257). Taken together these features and processes of urban

and non-urban regions underscore the potential for alcohol to play a different role in the lives of young people.

3.2.5 Social environment

A commonly overlooked element in studies of neighbourhood characteristics is the social environment (Yen and Syme, 1999), although generally gaining more attention in recent years. The two reviews that examined social neighbourhood effects on adolescent alcohol use found few studies of the social environment compared with indicators of neighbourhood income deprivation and alcohol availability (Bryden et al., 2013; Jackson et al., 2014). The complexity in the conceptualisation and operationalisation of the adolescent neighbourhood social environment will be discussed in further detail in Chapter 4. Although vague in terms of definition, generally the neighbourhood social environment can be broadly defined as the social dimensions of the neighbourhoods in which we live (Yen and Syme, 1999). The following sections will discuss findings that refer to the neighbourhood social environment in terms of the relationship to adolescent alcohol use.

3.2.5.1 Neighbourhood disorder

In terms of neighbourhood disorder and disorganisation Bryden et al.'s (2013) review found eleven studies that address associations with adolescent alcohol consumption. All of the studies were conducted in the US (with the exception of one which compared the US and Australian context). Overall, the measures used to quantify disorder ranged greatly from drug activity (i.e., Abdelrahman et al., 1999; Lambert et al., 2004), to vacant housing units (i.e., Reboussin et al., 2010), to survey measures that ask about perceptions of abandoned buildings or crime (i.e., Beyers et al., 2004; Byrnes et al., 2007). Additionally the drinking outcome measures also varied. These variations in both outcome and predictor measures limit the comparability of studies. Still, six of the

studies reported that increased disorder had a significant positive effect on adolescent drinking (Abdelrahman et al., 1999; Beyers et al., 2004; Lambert et al., 2004; Reyes et al., 2006; Scheier et al., 2000; Wilson et al., 2005). All of these studies reported perceptions of neighbourhood disorder at the individual-level.

Alternatively, Jackson et al.'s (2014) review found only four studies that examined neighbourhood disorder at the neighbourhood level. None of the studies used a similar measure. The measures ranged from perceptions of disorder (i.e., perceived crime) aggregated to the neighbourhood level (Fagan et al., 2007), to violent crime rates (Kulis et al., 2007), to overall crime rates (Snedker and Herting, 2008), and perceptions of abandoned buildings (Steen, 2010). Only one study found a positive significant relationship between disorder and adolescent drinking (Steen, 2010). Again, all studies were from the US.

There are very few studies that have examined neighbourhood level disorder and adolescent alcohol use since these reviews. In New Zealand, Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga (2016) found that disorder (measured by the presence of rough or broken footpaths, poor street lighting, no one caring about how the neighbourhood looks, too many dogs, and too much rubbish) was associated with high quantity drinking in adolescents under sixteen in the expected direction but no association was found in those 16 years or older (Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016). Additionally, a study in Taiwan found neighbourhood level violent crime was not associated with adolescent drinking but a significant interaction was present with parental drinking (Chen et al., 2016). These studies are an important move forward in understanding the role of neighbourhood disorder outside of the US context.

3.2.5.2 Neighbourhood positive relationships

Bryden et al. (2013) found five studies that explored adolescent drinking associations

with individual and neighbourhood level measures of neighbourhood attachment, closeness and supportiveness. All studies were conducted in the US, with the exception of a cross-national study examining the US and Australia. Overall, the findings were mixed but generally, individual adolescent perceptions predicted drinking outcomes (Beyers et al., 2004; DeHaan and Boljevac, 2010); while adult perceptions of the neighbourhood did not predict adolescent alcohol use (Ennett et al., 1997; DeHaan and Boljevac, 2010). One exception was a study from Chicago which found adult community leader perceptions of neighbourhood strength (measured by perceptions of: community identity, level of resources, participation in local activities, influence on policies by residents and prevention of alcohol use among teenagers) when adolescents were in grade 6 was significantly associated with problem drinking at grade 8 directly and indirectly through home alcohol access (Tobler et al., 2009).

Jackson et al. (2014) found that among the few studies that examined social environmental neighbourhood level effects on adolescent drinking there were mixed findings; but generally the trend was toward null findings at the neighbourhood level. A Swedish study, for example, examined neighbourhood social capital and adolescent alcohol use. Perceived neighbourhood social capital was measured using a 7-item scale that included questions about feeling safe, getting help from neighbours and neighbourhood physical conditions. A measure was also included that aggregated the scale to administrative boundaries by using the median of the individual measures (Åslund and Nilsson, 2013). They found a negative association was present for individual perceived social capital but no significant association at the neighbourhood level. Moreover, DeHaan and Boljevac (2010) found no significant relationship between neighbourhood support (measured by adult reports) at the school district level and lifetime or weekly drinking, in a rural sample of adolescents. Similarly, Ennett et al. (2008) found no significant relationship between adult collective efficacy and adult community support and adolescent drinking, in a US sample. However, these results may not be comparable to studies that use

adolescent reports of the neighbourhood environment (Byrnes et al., 2007). In a study of Florida youth, Steen (2010) found that a county measure of having neighbours available to talk to related negatively to ever having tried alcohol. Moreover, Fagan et al. (2007) found a significant association between past month drinking and binge drinking in younger adolescents and measures of neighbourhood attachment in 41 communities (predictors measured at 6th grade and outcomes at 8th grade) but no significant association among older students (predictors measured at 8th grade and outcomes at 10th grade).

Some further evidence has emerged in the years since these two reviews. Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga (2016) found that neighbourhood level collective efficacy (measured by items of social cohesion: neighbourhood trust, belonging, helpfulness and friendliness, as well as social control: measured by how often their parent wanted to know with who and where they were) was associated with high quantity drinking in adolescents under sixteen in the expected direction. Unexpectedly, neighbourhood level collective efficacy was positively associated with high quantity drinking among those sixteen and older in the sample of urban adolescents. Fagan et al. (2015) found that neighbourhood level collective efficacy, measured from adults' perceptions of social control and cohesion, was not related to any alcohol use in a sample of adolescents in Chicago. Similarly, Trucco et al. (2014) found in their study of adolescents from a county in New York State that parent perceived measures of neighbourhood level cohesion did not predict adolescent alcohol use. At the individual level Koutra et al. (2014) found in a Greek sample that perceived neighbourhood connections had a positive association with regular drinking for girls and that perceived neighbourhood trust and safety had a negative association on binge drinking. No effect was seen for boys. Wen (2017) found individual level parental perceptions of neighbourhood safety and social cohesion were not associated with adolescent lifetime drinking, in a sample from California.

3.2.5.3 Conclusions on the social environment

Evidence from past studies on the effects of the neighbourhood social environment on individual health outcomes and behaviours have not been conclusive (Morgan and Swann, 2004; Bryden et al., 2013; Jackson et al., 2014). Mixed results may be due to the influence of unaccounted for moderating factors (Bloomfield and Stock, 2013; Jackson et al., 2014), varying measures of the neighbourhood social environment (Martin, Inchley, Humphris and Currie, 2017; Trucco et al., 2014), or varying outcome measures (Bryden et al., 2013). To further complicate the issue neighbourhood social characteristics can be measured at the individual and neighbourhood level, and individual measures may moderate or mediate the effect of neighbourhood level measures (Martin, Inchley, Humphris and Currie, 2017). Understanding which level is associated with adolescent drinking is important in understanding which level prevention or intervention policies should occur (people or places). More clarity is needed in conceptualising and measuring the dimensions of adolescents' neighbourhood social environments in further studies so that appropriate study comparisons can be made.

3.3 Summary

The broad theme that emerged from this narrative review is that a lack of consistent evidence exists examining the potential determinants of neighbourhood variation in adolescent alcohol use. Perhaps the most consistent evidence of neighbourhood influences on adolescent drinking behaviours points to an urban/rural disparity in adolescent drinking behaviour. Gaining a better understanding of the underlying mechanisms that influence this pattern would aid in developing policies that could reduce adolescent alcohol use in rural areas therefore reducing inequalities.

Generally, inconsistent findings may be due to differences in the drinking outcome analysed, differences in how the neighbourhood characteristics are measured (different

measures or different scales), or contextual differences. Moving forward, researchers should attempt to compare like to like when examining results. Moreover, national and local studies outside of the US context are needed to best inform targeted prevention and intervention strategies in other geographical and cultural contexts. Overall, further studies are needed that are designed based on theory (Holmes et al., 2014) and that consider potential moderating and mediating effects to improve the evidence base to avoid including a mediator or moderator as a control variable thereby reducing the effect size when the true relationship is indirect (Jackson et al., 2014).

Moving forward further studies are needed to better understand the geographic patterns in adolescent drinking. It has been suggested that studies should focus on the influence of neighbourhood social characteristics on urban/rural differences in drinking outcomes (Lo et al., 2013).

Chapter 4

Conceptualising, measuring and evaluating constructs of the adolescent neighbourhood social environment: A systematic review

This chapter is partly based on the following work accepted for publication in SSM Population Health

Martin, G., Gavine, A., Inchley, J. and Currie, C. (2017). Conceptualizing, measuring and evaluating constructs of the adolescent neighbourhood social environment: A systematic review. SSM-Population Health, 3, 335-351.

4.1 Introduction

Much work in the late 1990s and early 2000s highlighted the emerging role of the neighbourhood social environment in public health research. These works described the influence of neighbourhood social processes on individual health and well-being outcomes and highlighted the need for better understandings of how we conceptualise and measure the social environment (i.e., Yen and Syme, 1999; Morrow, 1999, 2001; Earls and Carlson, 2001). Overall, the neighbourhood social environment is defined as the social dimensions of the neighbourhoods in which we live (Yen and Syme, 1999). However, the complexity of these social dimensions leads to ambiguity of definitions that creates difficulties in measurement (Earls and Carlson, 2001).

In a seminal paper, Sampson et al. (2002) synthesised the evidence on the role of the social environment on health behaviours and outcomes, with a particular focus on adolescents. The authors provided a summary of neighbourhood social mechanisms, extending beyond more traditional measures of neighbourhood deprivation, and drew several conclusions regarding future research directions. They concluded that, related to issues of consistency in how measures were operationalised and theoretically situated, questions remained as to whether the neighbourhood social environment is best measured by a few higher-level constructs or several sub-domains. Additionally, while community-based surveys were found to yield valid measurements of the neighbourhood social environment, methods for evaluating ecological (aggregate) measures, termed 'ecometrics', were not widespread, though needed in a multilevel framework (Earls and Carlson, 2001; Sampson et al., 2002). More than a decade later much inconsistency and debate still exists regarding how best to conceptualise and measure the neighbourhood social environment, particularly when studying adolescents.

Among adolescents, choice and freedom to engage in behaviours is influenced, at least in part, by the neighbourhoods in which they live (Morrow, 1999, 2001). Adolescents are active agents within their neighbourhoods; however, their agencies within

the wider social and physical environments are widely overlooked in studies that utilise adult-centred measures (Morrow, 1999; Paiva et al., 2014). This signifies a methodological weakness as adult perceptions of the neighbourhood cannot fully represent the perceptions that young people have of their environment (Schaefer-McDaniel, 2004). Some evidence of this is provided by studies that examine both perceptions of adolescents and adults and find differing results on outcomes (Byrnes et al., 2007, 2013; De Haan et al., 2010). Therefore, it is reasoned that adolescent-centred approaches are more theoretically valid than adult measures of the adolescent environment, as young people may have different perceptions of their neighbourhood than adults, are generally exposed to fewer neighbourhoods due to a relative lack of mobility and may have access to different areas within their neighbourhood.

The use of good quality instruments is necessary when examining associations between adolescents' neighbourhood social environments and their health and well-being. Different approaches are taken to conceptualisation, operationalisation and measurement which might explain inconsistent research findings (Sampson et al., 2002). Reviews examining the social environment and similar health outcomes (i.e. alcohol use) have found conflicting results between studies (Bryden et al., 2013; Jackson et al., 2014) which may be due to considerable heterogeneity in how the neighbourhood social environment is measured.

The neighbourhood social environment is often measured at different levels. The individual level represents the survey respondent's perception of their neighbourhood, while the neighbourhood level represents the combined characteristics of all survey respondents in that area. Ecological neighbourhood level measures are relevant to research of neighbourhoods and health so that the researcher can address health outcomes that vary across places, independent of the resident's individual level characteristics (Hawe and Shiell, 2000). Moreover, neighbourhood level exposures may be mediated by the corresponding individual level measure. As social processes occur at a neighbourhood

level, measurement of ecological constructs represents a collective phenomenon; consequently, neighbourhood level measures are essential to better understand what makes some places more or less healthy and inform place-based interventions (Sampson et al., 2002).

The aim of this systematic review was to identify measures currently available relating to the neighbourhood social environment in research with adolescents, and make recommendations about the future use, development and application of such measures. Specifically, as a growing number of studies are utilising survey-based measures when examining health outcomes, there is a need for future research to assess validity and reliability of existing measures both at the individual (perceived) and neighbourhood (aggregate) level. This systematic review will present a critical review and evaluation of how the neighbourhood social environment has been measured in studies of adolescents. It is appropriate to critically examine such studies, as this is an area of increasing research interest, yet little is known about the reliability and validity of instruments used, or how concepts are operationalised and theorised. It is clear that questions about the reliability and validity of measures affect the evaluation of study results; therefore this study will provide a framework for the use of such measures in studies of the adolescent social environment.

The specific objectives of the systematic review are as follows:

1) To assess the methodological quality of studies reporting on measures of the neighbourhood social environment.

2) To critically review and compare how these measures are conceptualised and operationalised.

3) To make recommendations for future use of neighbourhood social environmental measures in studies of adolescents.

4.2 Methods

4.2.1 Inclusion/exclusion criteria

Studies were included if they: 1) reported on quantitative studies published in a peer-reviewed journal, and 2) reported the use, original development, or refinement of tools that have been developed to measure the neighbourhood social environment, as perceived by adolescents. To ensure that the neighbourhood social environment remained the focus of the study, only geographically bound measures about perceptions of the local areas in which adolescents live and spend their time (i.e., the question specifically referred to 'local area', 'neighbourhood', 'community', etc.), were included. The population was limited to the WHO definition of adolescence (10-19 years of age or if age was not stated, the corresponding school grades of 5-12, or equivalent i.e., P7 – S6 in Scotland) (World Health Organization, 2017).

The following studies were considered beyond the scope of this review and were therefore excluded: 1) studies examining macro-environmental factors (e.g. experiences of terrorist attacks or living in a war zone), 2) studies examining social conditions of the school or family, 3) general quality of life indicators, 4) measures that solely related to the physical or built environment, 5) studies where neighbourhood socio-economic status was the only predictor of the social environment, and 6) studies which focused on measures of community violence and/or substance misuse.

In addition, studies which utilised measures that only consisted of one item, or did not provide full details of items used in the research, or provide a citation of where these items can be found, were not included due to dearth of detail preventing a meaningful assessment of measurement operationalisation.

Studies were limited to those written in English and publications listed on databases from 2001 (the cut-off year of Sampson et al.'s 2002 review, thus providing an update to some components of that review) to Aug 18th, 2014. If a study contained multiple

measures, only measures that met the above criteria were discussed.

4.3 Search strategy

A detailed systematic review protocol was registered with PROSPERO (registration ID: CRD42014014721) (Appendix A). Studies were identified by a search of six databases on August 18th, 2014: Medline (via EBSCO), Scopus, Applied Social Science Index and Abstracts (ASSIA) which includes the Institute of Educational Sciences (ERIC) database, Cumulative Index to Nursing and Allied Health Literature (CINAHL) (via EBSCO), Web of Science, and PsycInfo (via EBSCO). The search architecture (Appendix B) was developed drawing on past reviews of the neighbourhood social environment that reported search terms (Bryden et al., 2013; Jackson et al., 2014; McPherson et al., 2013; Vyncke et al., 2013), using an initial scoping of the literature, and through discussions with supervisors and another researcher with expertise in systematic reviews (Dr. Anna Gavine).

4.4 Study selection process

The records identified from the database searches were imported into Endnote and de-duplicated. Due to time constraints, only I, personally, screened all titles and abstracts and a second researcher (Dr. Anna Gavine) independently screened a sample of fifteen percent of the abstracts to explore whether the application of the inclusion/exclusion criteria to the identified records was appropriate. Inter-rater agreement was quantified by examining simple percentages, as Kappa scores are rarely more informative than using this approach (Gough et al., 2012). Disagreements were resolved by discussion with the goal of consensus. Any studies that potentially met the inclusion criteria were retrieved and full text was screened by myself.

4.4.1 Quality assessment

Evaluations of the methodological quality of psychometric measures were assessed using the 4-Point COnsensus-based Standards from the selection of health status Measurement INstruments (COSMIN) checklist (Mokkink et al., 2010; Terwee et al., 2012). This module-based standardised instrument was designed to evaluate the methodological quality of studies presenting measures from health status questionnaires, in terms of their reliability and validity reporting (Paalman et al., 2013). Similar to past studies who used the COSMIN checklist (Ammann-Reiffer et al., 2014; Reimers et al., 2013) a subset of the modules appropriate to the included studies was used. Reliability and validity were assessed using questions from "Box A-Internal Consistency" and "Box E -Structural Validity" (duplicate or overlapping questions were only assessed once- see table 4.1). Where necessary it was also noted when aggregate (neighbourhood level) measures were derived and, in the absence of a quality appraisal tool for ecological (aggregate) measures, any attempts made to describe their reliability or validity.

4.4.2 Data extraction

Studies were organised by measurement concept (i.e. social control, neighbourhood support, etc.; table 4.2). Where a single study reported multiple measures, it was listed multiple times. Where data were duplicated in multiple studies for the same population, a note was made and data extraction only occurred once. Data were extracted on the study characteristics of: geographic region, urban/rurality, participants' age, sample size, and the number and size of aggregate neighbourhoods (if applicable).

Table 4.1: Modified COSMIN checklist for methodological quality assessment

		Excellent	Good	Fair	Poor	NA
1	Was the percentage of missing items given?	Percentage of missing items described	Percentage of missing items NOT described	-	-	-
2	Was there a description of how missing items were handled?	Described how missing items were handled	Not described but can deduce how missing items were handled	Not clear how missing items were handled	-	-
3	For Classical Test Theory (CTT) was Cronbach's alpha calculated? / For IRT Was a goodness of fit statistic at the global level calculated?	Cronbach's alpha or KR-20 calculated/ Goodness of fit statistic at a global level calculated	-	Only item-total correlations calculated/-	Cronbach's alpha or KR-20 NOT calculated/ Goodness of fit statistic at a global level NOT calculated	-
4	Was the sample size included in the internal consistency adequate?	Adequate sample size (>100)	Good sample size (50-99)	Moderate sample size (30-49)	Small sample size (<30)	If 3 is poor
5	For CTT: Was exploratory or confirmatory factor analysis performed? / For IRT: Were IRT tests for determining (uni-)dimensionality of the items performed?	Exploratory or confirmatory factor analysis performed and type of factor analysis appropriate in view of existing information/IRT test for determining (uni-)dimensionality performed	Exploratory factor analysis performed while confirmatory would have been more appropriate/ -	-	No Exploratory or confirmatory factor analysis performed/ IRT test for determining (uni-)dimensionality NOT performed	-
6	Was an internal consistency statistic calculated for each (unidimensional) (sub) scale separately?	Internal consistency statistic calculated for each subscale separately	-	-	Internal consistency statistic NOT calculated for each subscale separately	-
7	Was the sample size included in the (uni-)dimensionality analysis adequate?	7*# items and >100	5*#items and >100 OR 6-7*#items but <100	5*#items but <100	<5*#items	If 5 is poor
8	Were there any important flaws in the design or methods of the study?	No other important methodological flaws in the design or execution of the study	-	Other minor methodological flaws in the design or execution of the study	Other important methodological flaws the design or execution of the study	-

Table 4.2: Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Informal social control									
Kerrigan et al. (2006)	Neighbourhood collective monitoring	343	14-19	Baltimore	Urban	EFA	4	0.80	No
Law and Barber (2007)	Collective social control	676	Grades 5 and 8	Ogden, Utah	?	EFA	3	0.69	No
Neumann et al. (2010) & Barker et al. (2011)	Informal social control	4597	12	Edinburgh	Urban	CFA	6	0.58	No
Oliva et al. (2011)	Social control	2400	12-17	Western Andalusia, Spain	Mixed	EFA and CFA	4	0.85	No
Attachment/Sense of belonging/connectedness									
Albanesi et al. (2007)	Sense of belonging	566	14-19	Mantova and San Giovanni in Northern Italy	Mixed	CFA	9	0.85	No
Chessi et al. (2010)[a]	Sense of belonging	661	15-18	Town in Northern Italy	Midsized town	EFA and CFA	4	0.82	No

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Karcher and Sass (2010)	Sense of community connectedness	3633	Grades 6-8	Midwest US city	Urban	CFA	6	0.85	No
Mayberry et al. (2009)	Sense of community	14,548	Grades 9-12	Dane County Midwest US county	?	EFA and CFA	6	0.77	Yes; aggregated to school level; no reliability reported
Oliva et al. (2011)	Attachment to neighbourhood	2400	12-17	Western Andalusia, Spain	Mixed	EFA and CFA	4	0.91	No
Perez-Smith et al. (2001)	Neighbourhood affiliation (attachment)	167	14-19	Baltimore, US	Urban	EFA	9	0.92	No
Van Gundy et al. (2011)	Community attachment	1310	Grades 7-11	Coös County and Southern New Hampshire, US	Mixed	EFA	4	0.72	No

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Zani et al. (2001)	Membership	823	14-19	North Central Italy	Mixed	EFA	4	0.64	No
Opportunities for prosocial involvement									
Albanesi et al. (2007)	Satisfaction of needs and opportunities for involvement	566	14-19	Mantova and San Giovanni in Northern Italy	Mixed	CFA	7	0.82	No
	Opportunities for influence	566	14-19	Mantova and San Giovanni in Northern Italy	Mixed	CFA	4	0.71	No
Baheiraei et al. (2014)[d]	Opportunities for prosocial involvement	753	15-18	Tehran, Iran	Urban	CFA	3	0.79	No

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Chessi et al. (2010)[a]	Satisfaction of needs and opportunities for involvement	661	15-18	Town in Northern Italy	Midsized town	EFA and CFA	4	0.76	No
	Opportunities for influence	661	15-18	Town in Northern Italy	Midsized town	EFA and CFA	4	0.74	No
Zani et al. (2001)	Opportunities for participation and fulfilment of needs	823	14-19	North Central Italy	Mixed	EFA	6	0.65	No
Support									
Albanesi et al. (2007)	Support and emotional connection in the community	566	14-19	Mantova and San Giovanni in Northern Italy	Mixed	CFA	6	0.81	No

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
	Support and emotional connections with peers	566	14-19	Mantova and San Giovanni in Northern Italy	Mixed	CFA	10	0.90	No
Anthony & Stone (2010)[e]	Neighbourhood supportive adults	20749	Grades 6-12	US	?	IRT	12	0.81	No
Chessi et al. (2010)a	Support and emotional connection in the community	661	15-18	Town in Northern Italy	Midsized town	EFA and CFA	4	0.77	No
	Support and emotional connections with peers	661	15-18	Town in Northern Italy	Midsized town	EFA and CFA	4	0.88	No
Crean (2012)	Neighbourhood adult support	2611	Grades 6-8	Upstate New York, US	Urban	CFA	4	0.75	No

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
DeHaan & Boljevac (2010)	Community supportiveness	1424	11-15	Northern Plains, US	Rural	EFA	8	0.91	No
Oliva et al. (2011)	Support and empowerment of youth	2400	12-17	Western Andalusia, Spain	Mixed	EFA and CFA	6	0.91	No
Safety/security									
Anthony & Stone (2010)[e]	Neighbourhood safety	20749	Grades 6-12	US	?	IRT	12	0.80	No
Nichol et al. (2010)	Neighbourhood safety	9114	Grades 6-10	Canada	Mixed	EFA	3	0.68	Yes;182 schools means; no reliability reported
Oliva et al. (2011)	Security	2400	12-17	Western Andalusia, Spain	Mixed	EFA and CFA	4	0.87	No
Meier et al (2008)	Neighbourhood risk	85,301	10-19	Iowa, USA	Mixed	EFA	7	0.80	No
Detachment									

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Baheiraei et al. (2014)[d]	Low neighbourhood attachment	753	15-18	Tehran, Iran	Urban	CFA	2	0.64	No
Choi et al. (2006)	Lack of attachment to neighbourhood	2336	10-14	Seattle, US	Urban	CFA	5	0.78	No
Van Gundy et al. (2011)	Community detachment	1310	Grades 7-11	Coös County and Southern New Hampshire, US	Mixed	EFA	3	0.74	No
Disorganisation									
Baheiraei et al. (2014)[d]	Community disorganisation	753	15-18	Tehran, Iran	Urban	CFA	5	0.75	No
Lee (2010)	Social disorganization	485	10-15	Southern US	?	EFA and CFA	3	0.45	No

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Ward and Laughlin (2003)	Social disorganization	6504	Grades 7-12	US	Mixed	EFA	6	0.69	Yes;72 schools; dispersion around the mean; coefficient of variation used to examine reliability
Winstanley et al. (2008)	Neighbourhood disorganization	38115	12-17	US	Mixed	EFA	8	0.73	No
Disorder/deterioration									
Ewart and Suchday (2002)	Neighbourhood disorder	212	High school students	Baltimore, US	Urban	EFA	11	0.88	No
Law and Barber (2007)	Problems in the neighbourhood	676	Grades 5 and 8	Ogden, Utah, US	?	EFA	3	0.79	No

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Suchday et al. (2010)[c]	Neighbourhood disorder	163	Grade 10	New Delphi, India	Urban	CFA	6	0.76	No
Vowell (2007)	Neighbourhood deterioration	8072	Grades 10 -12	Southern state in the US	Mixed	CFA	5	0.75	No
Wilson et al. (2004)	Neighbourhood disorder	369	Middle schools	Three states in the US	?	EFA	6	0.87	No
Social cohesion									
Kerrigan et al. (2006)	Neighbourhood social cohesion	343	14-19	Baltimore, US	Urban	EFA	3	0.79	No
Community integration									
Law and Barber (2007)	Community social integration	676	Grades 5 and 8	Ogden, Utah	?	EFA	3	0.63	No
Sorribas et al. (2014)	Community integration	191	Grade 11 and 12	Barcelona, E and W Valles of Catalonia, Spain	?	EFA	3	0.62	No
Rewards for prosocial involvement									

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Baheiraei et al. (2014)[d]	Rewards for prosocial environment	753	15-18	Tehran, Iran	Urban	CFA	2	0.83	No
Social Capital									
Vafaei et al. (2014)	Social capital	23532	11-15	Canada	Mixed	EFA and CFA	5	0.76	Yes; 436 school means; no reliability reported
Quality									
Ceballo et al. (2004)	Neighbourhood quality	262	Grades 7 and 8	Midwest city in the US	Midsized city	EFA	4	0.61	Yes- 20 Census tracts mean no reliability
van de Bree et al. (2009)[b]	Neighbourhood quality	10,433	11-18	US	Mixed	EFA	6	0.63	No
Available activities									
Oliva et al. (2011)	Availability of youth activities	2400	12-17	Western Andalusia, Spain	Mixed	EFA and CFA	4	0.80	No

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Social resources									
Widome et al. (2008)[f]	Neighbourhood social resources	118	11-13	Minneapolis, US	Urban	EFA	8	0.76	No
Social climate									
Zani et al. (2001)	Social climate	823	14-19	North Central Italy	Mixed	EFA	2	0.64	No
Youth behaviour									
Anthony & Stone (2010)[e]	Neighbourhood youth behaviour	20749	Grades 6-12	US	?	IRT	8	0.87	No
Community participation									
Sorribas et al. (2014)	Community participation	191	Grade 11 and 12	Barcelona, E and W Valles of Catalonia, Spain	?	EFA	6	0.63	No
Pleasantness of living area									
Zani et al. (2001)	Pleasantness of living area	823	14-19	North Central Italy	Mixed	EFA	4	0.68	No
Protective community									

Studies included in narrative synthesis

Reference	Author(s) measure description	Sample size	Participant's age or grade	Region	Urban/ rurality	Psychometric method	Number of items	Measure reliability Cronbach's alpha	Aggregate measure
Clark et al. (2011)[d]	Community protective	907	Grades 10 and 12	Virginia, US	Mixed	EFA	7	0.80	No

EFA = exploratory factor analysis; CFA = confirmatory factor analysis; IRT = item response theory; US = United States of America

a This is a shortened version of the scaled used by Albanesi et al. (2007)

b The questions utilised are the same as Ward and Laughlin (2003) Social Disorder Scale and both use US National Longitudinal Study of Adolescent Health (Add Health) data however, the subsample varies slightly

c Adapted from Ewart and Suchday (2002)

d Adapted from the Communities-that-Care (CTC) questionnaire - this questionnaire also has measures about norms and availability of substances that were not extracted for this review as per the inclusion criteria

e Anthony and Stone (2010) secondary analysis of the School Success Profile

f Widome et al. (2008) also had a scale of intention to contribute but this was not included because it had several items that were not geographically bound

4.4.3 Synthesis

A narrative approach was used to synthesise the results of the review. To support this, each measure discussed in the manuscripts was coded based on the author's terminology (i.e. collective efficacy, social capital, social control, etc.), and these were then grouped into conceptual themes, for example, informal social control, collective monitoring and collective social control were all grouped as social control. This approach was used to differentiate each author's conceptualisation of the social process under study (see table 4.2). Secondly, the items used to measure each conceptual theme were coded in order to critically assess similarities and differences within and between conceptual themes (for details on item coding see Appendix C).

In order to ensure that the measurement instruments were of sufficient quality to draw appropriate conclusions, it was decided post-hoc that studies where the instrument reporting was deemed poor quality (based on lack of reliability and structural validity reporting from the COSMIN checklist) would not be included in the narrative synthesis. This was due to a large number of studies with poor quality reporting or insufficient information to make an assessment of quality. Specifically, if a study's instrument reporting was rated as poor on any question in the modified COSMIN it was considered of poor quality. This cut-off is in line with the "worst score counts" algorithm outlined in Mokkink et al. (2012). Because of this, any study not reporting reliability, in terms of internal consistency and structural validity of each measure, was not included in the narrative synthesis.

4.5 Results

The search yielded a total of 13689 unique articles. Scanning these titles and abstracts yielded 683 articles that were further assessed for eligibility through full-text screening. Inter-rater agreement in the sample of fifteen percent of titles and abstracts

double-screened was ninety-seven percent which suggested good agreement between the reviewers. Outstanding disagreements were resolved by the two reviewers through discussion. Upon screening the full-texts of the 683 articles (Appendix D), 205 met the inclusion criteria and were further assessed for quality using the COSMIN checklist. This led to exclusion of 651 articles in total. Thus, a total of 32 studies (containing 56 unique measures) were rated as sufficient quality to include in the narrative synthesis (figure 4.1).

Of the 32 studies, the majority were conducted in the Europe or North America (US = 21). Only two studies were conducted in regions outside of Europe or North America. Approximately an equal number of studies were conducted in urban and mixed areas. Only one study was conducted in a solely rural environment. One paper used item response theory to examine reliability and structural validity; all others used classical test theory methods. Moreover, only five studies derived aggregate neighbourhood measures, with four of these using school as a proxy for residential neighbourhood. Reliability of aggregate neighbourhood measures was not addressed for most of these studies.

General characteristics of the measures included in this review are presented in table 4.2. Of the 56 social environment measures the minimum number of items was two and the maximum was 15. The minimum Cronbach's alpha was 0.45 and the maximum was 0.92. It has been suggested that an alpha between .70 and .90 is desirable, as an alpha that is too high may suggest that some items are redundant (Tavakol and Dennick, 2011); just over half of the 56 measures fell within this range. As shown in table 4.2, concepts relating to sense of community belonging and neighbourhood support were the most prevalent.

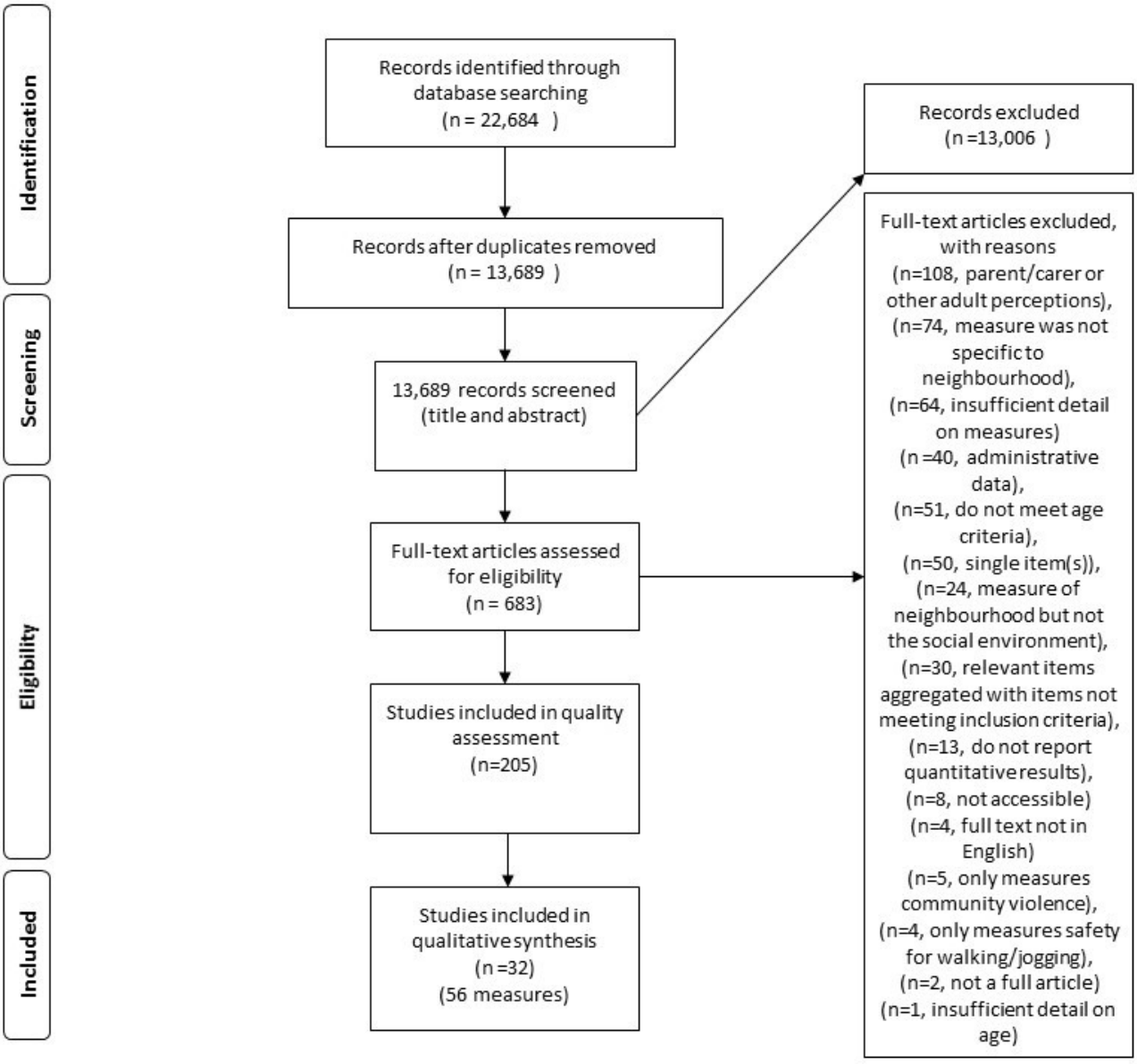

Figure 4.1: PRISMA flow diagram showing search results and exclusions

4.5.1 How do studies conceptualise and operationalise neighbourhood social measures?

Many studies based their conceptualisation of neighbourhood measures on broader theoretical models. The theoretical models that were discussed in studies most frequently

were: 1) the social development model (which is the basis for the Communities that Care Survey) (Baheiraei et al., 2014; Mayberry et al., 2009; Widome et al., 2008) 2) Bronfenbrenner's ecological systems theory (Anthony and Stone, 2010; Lee, 2010; Neumann et al., 2010; Oliva et al., 2012; Perez-Smith et al., 2001), 3) the social disorganisation model (Mayberry et al., 2009; Perez-Smith et al., 2001; Vowell, 2007; Ward and Laughlin, 2003) and 4) theories of sense of community (Albanesi et al., 2007; Chiessi et al., 2010; Zani et al., 2001).

An overarching theme within these bodies of research was that various measures of the neighbourhood social environment are somehow interconnected. For example, Oliva et al. (2012) describe the concepts of neighbourhood assets, neighbourhood social capital, social organisation, trust, neighbourhood attachment or belonging, and collective efficacy as associated concepts when discussing how community contributes to the empowerment and maturity of adolescents.

> "In some ways, this claim is similar to the concept of social capital, which is understood as those features of social organization, such as existing social networks and mutual trust, which facilitate action and cooperation for mutual benefit between members of a community (Halpern 2005; Putnam 1993). According to some authors, this social capital has a positive influence on the feeling of emotional attachment or belonging to the neighbourhood in which the members reside. This may increase their desire to actively engage in community service, which has been defined by some as collective efficacy (Cancino 2005)" Oliva et al. (2012, p.524)

Another example of how conceptualisations of various social neighbourhood measures overlap is addressed in the discussion of social cohesion. Vafaei et al. (2014) considered their social capital measure as incorporating elements of cooperation, trust and *cohesion*. The authors then discuss social cohesion as based on interpersonal relationships and the availability of safe places to spend time and interact. Meier et al.

(2008) discussed their measure in terms of collective efficacy, stating that they used items that referred to *social cohesion* as well as informal social control; however, they use the more generic term of "neighbourhood risk" to label their measure. In contrast, *social cohesion* was discussed in other research as an overarching domain. For example, Van Gundy et al. (2011) described their measures of community attachment and detachment as being two components of cohesion.

Additionally, although some authors stated that different concepts are used in their analysis, there is evidence that these concepts were not always theoretically distinct. For example, van den Bree et al. (2009) "neighbourhood quality" measure used the same items (although anchored in opposite directions) with an adjusted sample as Ward and Laughlin (2003) "social disorganization" measure.

When examining the items that are used to *operationalise* the various thematic concepts of the adolescent social environment, a similar picture emerges (see Figure 4.2). There was much overlap in the items used to measure the various concepts. For example, items that illicit information of adolescent's perceptions of deviant behaviours appeared in scales that were conceptually defined as neighbourhood safety, disorder, disorganisation, quality, and youth behaviour. Similarly, items asking about adolescent's perceptions of positive interpersonal connections in their neighbourhood were utilised in measures of a range of concepts including support, sense of belonging, safety, resources, social capital and social cohesion. Across studies, neighbourhood safety was presented as both a conceptual theme as well as an item used to measure various concepts, such as, quality, social capital, attachment/sense of belonging/connectedness. These results further suggest that the distinction between concepts is blurred thus suggesting the need for a greater differentiation between some concepts and a theoretical linking of highly related concepts.

Based on the items included in the measures, some concepts did emerge as divergent from others. Across studies, the concept of social control was only measured using

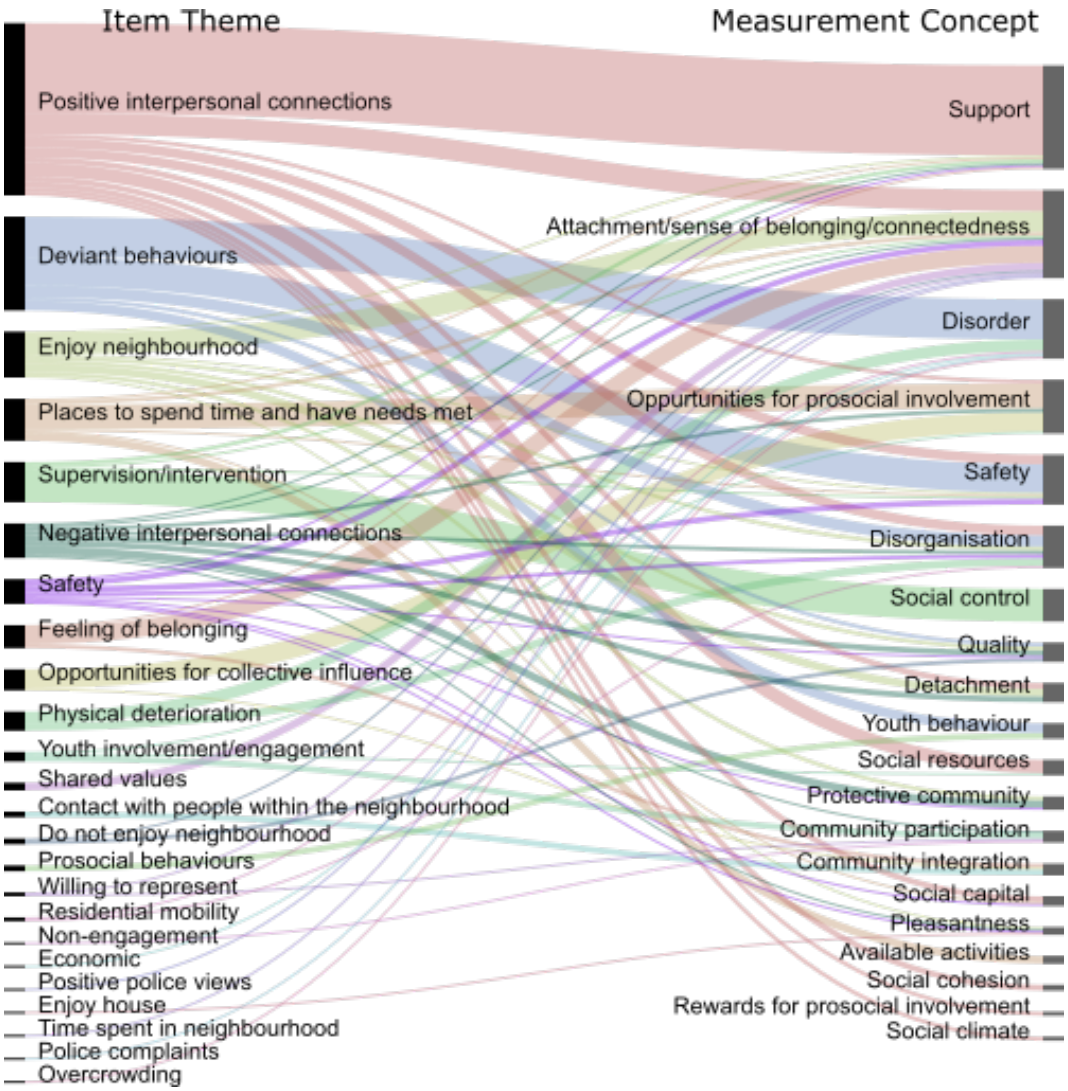

Figure 4.2: Alluvial diagram of question item themes used in measurement of various author defined concepts. Height of nodes indicates number of items in each theme. Diagram was created using http://app.raw.densitydesign.org/

questions about supervision and intervention of behaviours within the neighbourhood. Moreover, the concepts of disorder and safety, for the most part, were measured using items regarding deviant behaviours; however, disorder measures also included some items referring to physical deterioration.

4.6 Discussion

The aim of this chapter was to review measures of the adolescent neighbourhood social environment. One of the starkest findings was how many studies were identified as having poor quality reliability and/or validity reporting. This likely exacerbates confusion surrounding the concepts related to the neighbourhood social environment, both in research and in public policy. Having good quality measurement instruments is necessary for identifying associations between the neighbourhood social environment and adolescent health outcomes; lack of methodological uniformity is, therefore, likely to be a contributing factor to inconsistent research findings. Despite the finding that many studies did not meet the quality cut-off, this review identified 56 measures of the neighbourhood social environment, where studies had sufficient quality in reporting. These measurement tools represent an encouraging basis in the field of measuring the neighbourhood social environment of adolescents. However, there is a need for further development or validation of existing measures outside of the US, particularly in non-westernised countries. Moreover, very few studies extend their measure to ecological areas, and those that do often use school as a proxy for neighbourhood. This is of concern, as the questions referred to the area in which adolescents live rather than area where they attend school. Consequently, these aggregate scales suffer from issues of face validity as adolescents may not live in the same area as where they go to school. Even fewer studies reported attempts to quantify the reliability and validity of ecological measures. This finding mirrors that of Sampson et al. (2002) and highlights that many studies addressing neighbourhood characteristics examine individual perceptions, but do not extend these measure to the neighbourhood level. This limits the informative power of these studies in terms of place-based interventions. Only one study utilised item response theory techniques; these techniques are useful for non-linear items and can be extended to neighbourhood level measures and are therefore of use in future studies (Matsueda and Drakulich, 2016).

Little consistency was found in how adolescent neighbourhood social environments have been both conceptualised and operationalised. When operationalised the various concepts of adolescent neighbourhood measures were largely indistinct. Again, this is similar to findings from the previous review by Sampson et al. (2002). There seems to be some understanding within the literature that various concepts are somehow related; however, a clear framework does not exist and is inconsistent and contradictory across studies. By scrutinising the literature, it appears that one neighbourhood measure - social control- appears distinct from other concepts, in that it was formulated only by measures of supervision and intervention by adults in the neighbourhood. Also, neighbourhood disorder (physical and social) and safety were largely distinct from measures such as support, cohesion, and attachment/sense of community and belonging, which used a high proportion of measures that deal with relationships and ties within the community. In advancing theory, emerging work conducted with different populations, such as adults, may prove informative.

Another issue that influenced the consistency of neighbourhood measures, was that although all survey questions referred to a geographical area where adolescents lived, there was no standardised definition of neighbourhood; i.e., Zani et al. (2001) used the term "town" as a whole, which differs greatly from 'the street where you live' or 'local area'. Different neighbourhood boundary definitions may apply in urban and rural locales; therefore further research is needed to better understand the perceptions of neighbourhood boundaries among young people who reside in different contexts.

Overall, it was found that despite the large number of studies of adolescents that have used a measure of the neighbourhood social environment since 2001, it appears that little progress has been made in terms of clarity of concepts. This has important implications for future research. In light of this, several technical recommendations are relevant and in line with many of the recommendations from Brandt et al. (2005). First, it is suggested that studies not using a previously valid and reliable scale report on the

psychometric properties of their measure, so that the research findings can be appropriately interpreted. Adaptation made to existing measurement scales, or use of scales in different cultural contexts, should be documented and the psychometric properties noted. Moving forward, researchers should stress improved conceptualisation and transparency in reporting; authors of original studies should provide a clear definition of the type/s of neighbourhood social environment that their measurement tool is attempting to assess and record all items in scale measures. This would ensure that results can be understood with greater clarity in terms of what is measured and therefore research and policy implications can be better enacted. This is of utmost importance, as a lack of comparability of studies limits growth in the field (Brandt et al., 2005). Whether certain sub-domains are distinct from others should be further examined with empirical evidence from cross-cultural studies (Reimers et al., 2013). Additionally, from a developmental perspective, whether measures are invariant for younger versus older adolescents is an important area of future research. Furthermore, studies should extend beyond the psychometric to the ecological (ecometric) as this is a key element in neighbourhood research (Sampson et al., 2002). Appropriate neighbourhood boundaries based on residence, and at an appropriate spatial-scale, should be selected when possible. Finally, it is suggested that reviews of effects of concepts relating to the social environment should consider multiple typologies in search terms to cover all studies.

A quality checklist of studies examining ecological constructs would be useful in future studies and would allow for the structural validity of neighbourhood measures to be determined without examining the individual level analogue constructs. However, in the absence of a standardised assessment tool, reliability reporting should be conducted using methods which draw on multilevel modelling to examine reliability, such as those outlined in Raudenbush and Sampson (1999). Convergent and divergent validity can be tested using similar approaches used in individual level constructs, by examining associations with other neighbourhood measures that are theoretically thought to be

correlated (Matsueda and Drakulich, 2016). It may be that individual level and neighbourhood level constructs vary in their composition and therefore methods to test their structural validity are needed. This is a topic that has received little attention but recent studies utilising methods such multilevel factor analysis provide a useful focus for future research (Dunn et al., 2015).

There are several limitations that should be considered when interpreting the results of this review. First, given the search strategy, unpublished studies or studies that were not published in indexed journals, were unable to be identified. Studies in languages other than English were also not included and the majority of the identified studies were conducted in high income countries, thus limiting the generalisability of the findings. The scope of this review did not address self-reports from different sources (such as parent, teacher or non-resident perceptions of the neighbourhood). Self-reports from multiple sources may be differentially associated with adolescent health outcomes, and the validity and reliability of these measures warrant future research. Given the strict age criterion, it is possible that some studies may have been overlooked, with much of the sample within the age limits; however, this criterion was deemed important to ensure comparability amongst studies, particularly in the context of adolescent development. Moreover, reducing the narrative synthesis to studies that provided sufficient information on psychometric properties, and did not score poorly on reliability and validity reporting, allowed for a more refined synthesis and comparison of measures; however, this excluded some papers that may be worthy of note. Two studies worth mentioning are: Arthur et al. (2002) and (Glaser et al., 2005) which, taken together, provide sufficient information to assess the measurement instrument qualities. These studies addressed the Communities that Care Survey items that were included in Baheiraei et al. (2014) study of Iranian adolescents and were the basis for Clark et al. (2011), so the survey instrument was still represented in this review. Another key limitation of this review was that the full text screening of articles, data extraction and

quality appraisal was conducted by only myself. However, given the high level of inter-rater agreement (97%) in the title and abstract screening, confidence can be had that the inclusion criteria were applied appropriately. Because this review was designed to examine conceptual and operational considerations in measurement instruments, and not to produce a pooled effect size from intervention studies, missing studies are of less concern.

In conclusion, the body of literature on the adolescent social neighbourhood environment represents a complex and fragmented set of findings. There is much room for improvement in terms of moving the field forward by further explicating both theory and methods. However, existing measures based on prominent theories provide a promising base on which to build future research.

Chapter 5

Conceptual framework

5.1 Introduction

Population health and social epidemiology often examine complex relationships with multiple interrelated factors existing at different levels. The SDH approach to public health (Marmot, 2005; Marmot and Wilkinson, 2007) argues that to improve adolescent health focus needs to be paid to the upstream social and cultural factors that influence health outcomes (Viner et al., 2012). Conceptual frameworks are used to guide the analyses of these complex relationships (Victora et al., 1997). The results of several empirical analyses suggest that an ecological approach to alcohol use among adolescents is appropriate and that theory should guide the neighbourhood attributes used in these investigations (Ennett et al., 2008). The research presented in this thesis will utilise a socio-ecological framework which posits that, for the adolescent, environmental factors (i.e., residential neighbourhood characteristics) affect their alcohol use (Brenner et al., 2011; Ennett et al., 2008). Three general theories of how neighbourhood influences adolescent behaviours are summarised: Bronfenbrenner's ecology of human development theory, social disorganisation theory, and the social development model. Additionally, several models are presented that narrow existing theories specifically to

alcohol use or substance use. Further, Stimpson et al. (2007) identified several pathways by which neighbourhood environmental factors may be related to individual health risk behaviours. These are reported in section 4.4.1. Lastly, these theories and pathways are combined to create a single framework to support the research reported in this thesis.

5.2 Bronfenbrenner's Ecology of Human Development Theory

Bronfenbrenner's ecology of human development theory was first developed in the 1970s and sought to expand the focus of research on youth beyond the individual, and therefore incorporates more real life situations (Bronfenbrenner, 1993). This framework highlights the need for a multidimensional perspective in examining outcomes relating to the development of adolescents within multiple and nested environments (Ennett et al., 2008). Proximal processes occur when an individual is interacting regularly with persons, objects and symbols in their immediate environment. Bronfenbenner states that the form of these proximal processes varies depending on both individual characteristics and more distal environment where the processes take place (i.e., neighbourhood environment). Often the proximal processes have a greater influence on the outcome than the more distal factors; yet relationships may vary due to the influence of the wider environment. Additionally, proximal processes may buffer environmental differences related to outcomes (Bronfenbrenner, 1993; Tanner-Smith, 2012). Consequently, Bronfenbenner predicts interactive effects rather than main effects will often be present when taking an ecological approach to analyses. To best conceptualise these relationships Bronfenbrenner sets out various nested levels in which all processes occur. The first level is the microsystem which represents the immediate environments of the individual in which proximal processes exist (i.e., for adolescents: family, school and peer groups). The second is the mesosystem which characterizes the linkages and processes

between microsystems, i.e., family drinking practices and school alcohol intervention policies. The third is the exosystem which represents linkages and processes between two or more larger settings, where microsystems are embedded, such as residential or school neighbourhoods. Further, there are macrosystems representing broader systems overarching patterns of the micro-, meso-, and exosystems, such as belief systems and bodies of knowledge, while chronosystems represent time i.e., developmental processes that vary due to life stage at a specific point in time (Bronfenbrenner, 1993).

5.3 Social disorganisation theory

Social disorganisation theory originated in the field of sociology but has been extended to public health in recent decades (i.e., Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016; Mayberry et al., 2009). It explains that neighbourhood characteristics are the foundation for social deviance (Shaw and McKay, 1942; Sampson et al., 1999). It is hypothesised that neighbourhood deprivation, increased residential mobility, and or ethnic heterogeneity predicts social deviance because it limits the ability of the neighbourhood to exert social control over its residents and reduces the levels of social cohesion within the neighbourhood (Sampson, 2012). Jaynes (2014) also points to several other direct and indirect effects of social disorganisation, such as neighbourhoods of concentrated poverty having limited alternative activities to substance use and other forms of 'delinquency'. Another explanation is that living in a neighbourhood that is socially disorganized creates stress and substance use may follow as a coping mechanism. This is a relationship that has been found among adults (Boardman et al., 2001). A major contribution of social disorganisation theory was the move away from a purely individualistic view of human behaviour to also considering collective processes (Jaynes, 2014). With the introduction of this theory, where individuals spend time was emphasized as a determining factor in human behaviour. This lends itself to advocating for policies to be targeted at the neighbourhood level in order

to influence individual behaviour change.

The implications of social disorganization theory for adolescent drinking are inconclusive with some studies pointing toward a relationship between collective efficacy and adolescent drinking and some finding no relationship (Bryden et al., 2013; Jackson et al., 2014). Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga (2016) examined the theory in terms of urban adolescents and found it was applicable to younger but not older adolescents. Because the theory was developed in the context of 'deviant' behaviours and it could be argued that alcohol use is considered normative among adolescents, an exploration of the applicability of this theory to different levels of drinking is therefore warranted. Additionally, this theory has been predominantly developed within the context of American cities, so it may be that the theory does not extend to rural regions or contexts outside of the US. In summary, social disorganization theory has made numerous important contributions in terms of understanding the influence of the neighbourhood environment, however, its application to adolescent drinking is yet unclear.

5.4 Social development model

The Social Development Model was developed by Hawkins and Weis (1985). It asserts that the most important units of socialisation for adolescents are family, schools, peers, and community, which all influence behaviour. This model builds on social control and social learning theory. It suggests that positive socialisation occurs in multiple spheres of influence and leads to increased attachment to others and a commitment and belief in societal order; thus limiting association with 'delinquent peers' and 'delinquent behaviours'. Specifically, social control theory posits that attachment to various realms of society and belief in the importance of social order form part of a social bond that limits 'delinquent behaviours'. It also posits that once a strong bond is formed between an individual and a socializing agent an informal control on behaviour is established (Cata-

lano et al., 1996). This is similar to aspects of social disorganisation theory. In contrast, social learning theory indicates that reinforcement of behaviours by those around the individual, contribute to the production of behaviours and thus has more of a focus on the process through which behaviour is developed. Social learning theory emphasizes that role models within the different levels are influential and that behaviours such as adolescent drinking are learned from those around them. By incorporating these two theories Hawkins and Weis (1985) suggest that strong social bonds, built from commitment, attachment, and belief, lead to relations with 'non-delinquent peers' and subsequently lead to 'non-delinquent behaviour'. In this model the neighbourhood is a distal factor that can have indirect impact on adolescent behaviour through norms and expectations that lead to conforming.

5.5 Conceptual models of adolescent alcohol use

5.5.1 Model of factors influences on alcohol and other drugs (excluding tobacco)

Bloomfield and Stock (2013) conducted a review of the research into neighbourhood influences on alcohol and other drugs (excluding tobacco) among youth and used this to develop a conceptual model outlining factors influencing alcohol and other drug use. They used key concepts from Bronfenbrenner's theory and identified variables or constructs related to alcohol and other drug use among youth that fit within the various levels of the framework. Unlike Bronfenbrenner's framework, Bloomfield and Stock's model conceptualizes school and workplaces as part of the mesosystem and neighbourhood as the exosystem (figure 5.1). This framework presents elements of the neighbourhood as being interrelated as well as interacting with the meso-level and microsystems. Neighbourhood factors are theorised to influence alcohol and other drug use both directly and indirectly.

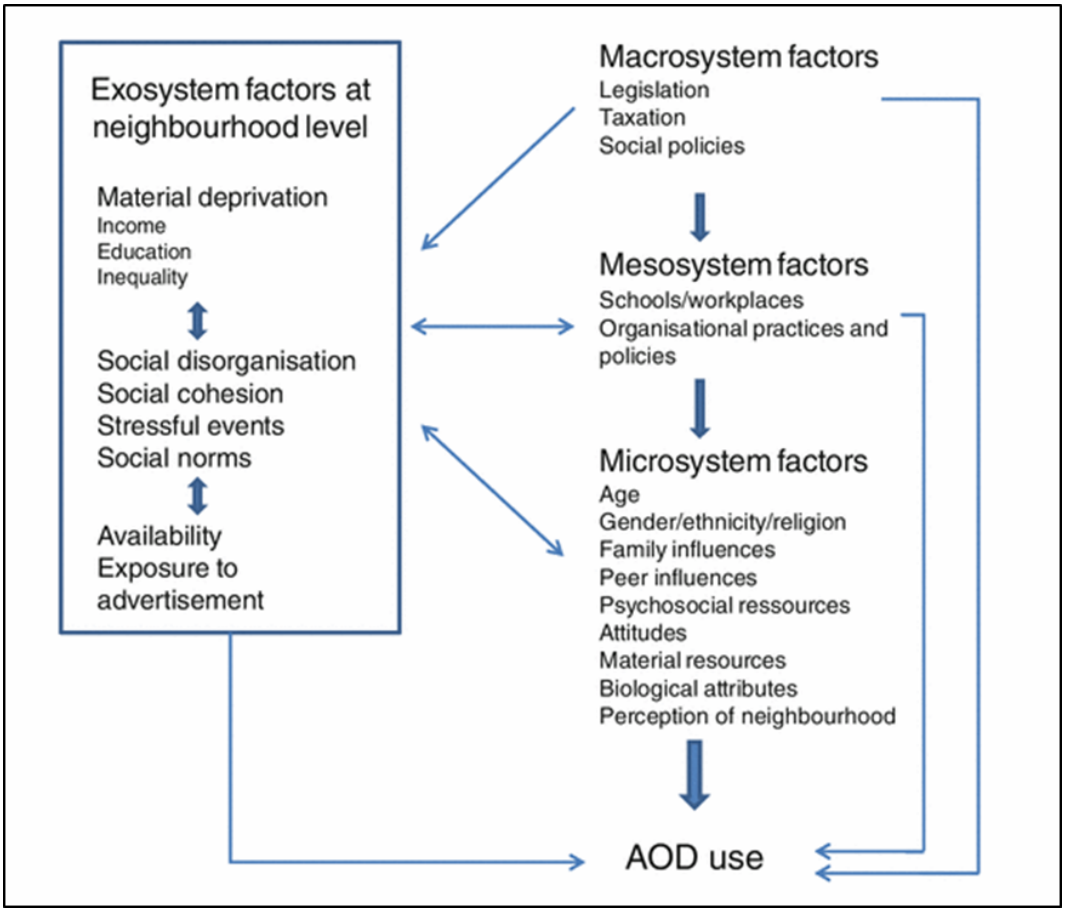

Figure 5.1: Conceptual model on factors influencing alcohol and other drug use in youth (from Bloomfield & Stock, 2013, used with permission from the copyright holder)

5.5.2 Social ecology of adolescent alcohol misuse

Ennett et al. (2008) developed a social ecological framework which includes multiple contexts with interdependencies. They state that these interdependencies should be considered when examining adolescent alcohol use. They also extend Bronfenbrenner's ecology of human development framework to adolescent alcohol misuse, and, like the social development model, include elements of social learning theory and social control theory. In this case social control and social learning theories are used to devise a set of variables to examine the overarching ecology of human development framework. The conceptual framework developed by Ennett et al. (2008) characterizes each context by four variables. Figure 5.2 presents Ennett et al.'s conceptual framework. Variables in bold (alcohol consumption by others in the adolescent's life) are measures of social learning; while those in italics are measures of social control (closeness, supervision and bonding within each context). In this model all four social contexts contribute to adolescent alcohol use and the contexts are interrelated, but neighbourhood surrounds the other contexts.

5.6 Proposed mechanisms between neighbourhood and adolescent alcohol use

Although the above frameworks touch on the mechanisms behind the theoretical links and adolescent alcohol use, several specific causal mechanisms (pathways) by which the neighbourhood may influence health risk behaviours have been proposed by Stimpson et al. (2007). The below section outlines such pathways.

5.6.1 Stress induced pathway

One hypothesized mechanism by which the neighbourhood environment may influence alcohol use is the stress induced pathway (Stimpson et al., 2007; Vinther-Larsen et al.,

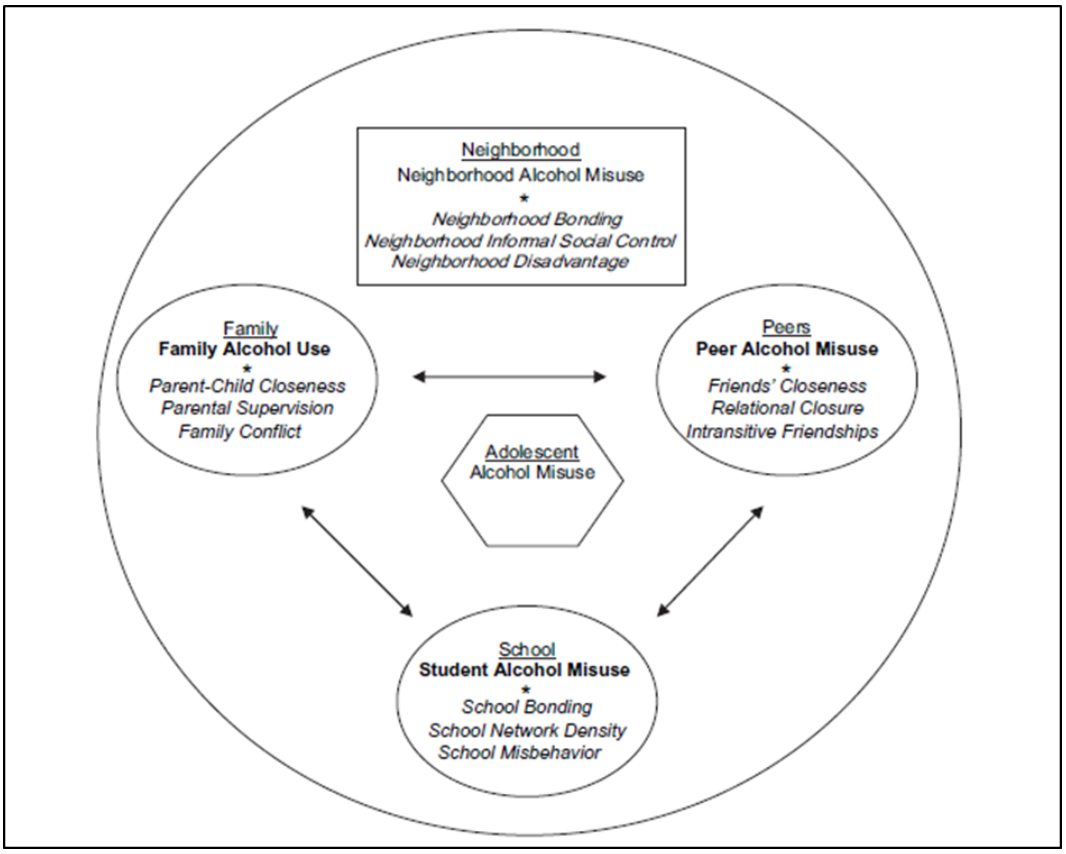

Figure 5.2: Social ecology of adolescent alcohol misuse conceptual framework, based on ecology of human development, social learning and social control theories (from Ennett et al., 2008, used with permission from the copyright holder)

2013). It is posited that living in areas which create distress (i.e., material deprivation and low social cohesion) results in risky behaviours such as alcohol consumption as a means to cope (Green et al., 2013; Vinther-Larsen et al., 2013). Neighbourhood factors that may induce or decrease stress are presented in both Bloomfield and Stock's and Ennett et al.'s conceptual frameworks. For instance high levels of neighbourhood disorder are theorized to be associated with a greater number of stressful life events and increased daily stress from the environment which could lead to drinking as a way to cope (Bloomfield and Stock, 2013; Boardman et al., 2001).

5.6.2 Social norms/contagion pathway

Behaviour is influenced by the culture and behaviours of others living in the same area (Sznitman et al., 2013; Vinther-Larsen et al., 2013). As posited by Stimpson et al. (2007) individuals may have similar beliefs based on the cultural norms and behaviours of those in their environment. This may occur among close knit social groups i.e. peer group norms (Stimpson et al., 2007) or among more distal groups i.e. school or neighbourhood norms (Ennett et al., 2008). Behaviours that are culturally influenced, such as alcohol consumption, may be strongly affected by the behaviours of others (Viner et al., 2012). Social learning theory as well as normalization theory are similar to the social norms pathway and are often discussed in terms of adolescent alcohol use (Ennett et al., 2008; Sznitman et al., 2013). Social learning theory was discussed in section 4.4 and is present in Ennett et al.'s framework at each level. Normalisation theory suggests that substance use is increasingly normalized by well-adjusted, non-risk taking young people who live in areas with high prevalence of alcohol use (Parker et al., 1999; Sznitman et al., 2013). Taken together these theories all hypothesize that the individual adolescents' alcohol use behaviours are affected by the wider drinking patterns found in their neighbourhood environment.

5.6.3 Structural pathways

The physical and social resources in a neighbourhood encourage or discourage health behaviours (Stimpson et al., 2007). In terms of adolescent alcohol consumption these resources may take the form of increased availability through high alcohol outlet density, increased exposure to alcohol marketing, or community services available for youth (Stimpson et al., 2007; Vinther-Larsen et al., 2013; Young et al., 2012). Additionally, it could be perceived that spaces that allow for adolescent alcohol consumption (i.e., unsupervised spaces) may present a resource for alcohol consumption. In Bloomfield and Stock's framework availability and exposure to marketing are present; these are

lacking in Ennett et al.'s framework.

5.7 Adapted socio-environmental conceptual framework

It is clear from the previous sections that ecological frameworks utilizing past empirical work can better guide future adolescent alcohol use research. It is also evident that some of the concepts presented here are overlapping and interrelated. For example, increased availability of alcohol within a neighbourhood may lead to more consumption which over time could affect social norms. An adapted conceptual framework was therefore developed to incorporate these ideas.

The adapted conceptual framework was developed merging the work of Bloomfield and Stock as well as Ennett et al. into one model. Additionally, the pathways in which the neighbourhood may influence adolescent alcohol use, as previously discussed in section 5.6, are also incorporated. The macrosystem factors include legislation, taxation and social policy as presented by Bloomfield and Stock (2013). Urban/rurality is also included at the macrosystem level as it represents a higher-level factor in which various physical and social conditions of the neighbourhood take place and adolescent alcohol use can be directly and indirectly impacted by urban/rurality, as discussed in Chapter 3 Section 3.2.4.

In the adapted conceptual framework presented in figure 5.3, elements of Ennett et al.'s as well as Bloomfield and Stock's frameworks are incorporated in that macro- and exosystem factors are shown to influence adolescent alcohol use. Factors at the macrolevel influence physical and social environments. The macrolevel may also impact on adolescent alcohol use directly. For example, legislation on legal drinking age and driving while under the influence, occurs at a macrolevel.

This framework also expands on previous work by incorporating the various pathways that may causally link the neighbourhood environment to adolescent alcohol use, namely the structural, stress and social norms/contagion pathways discussed above.

Additionally, neighbourhood factors are presented as interacting with each other and with individual level factors.

In this adapted framework the neighbourhood environment may be thought of as where adolescents spend their time and therefore where exposure is likely to take place (for adolescents this is probably the areas surrounding their home or school).

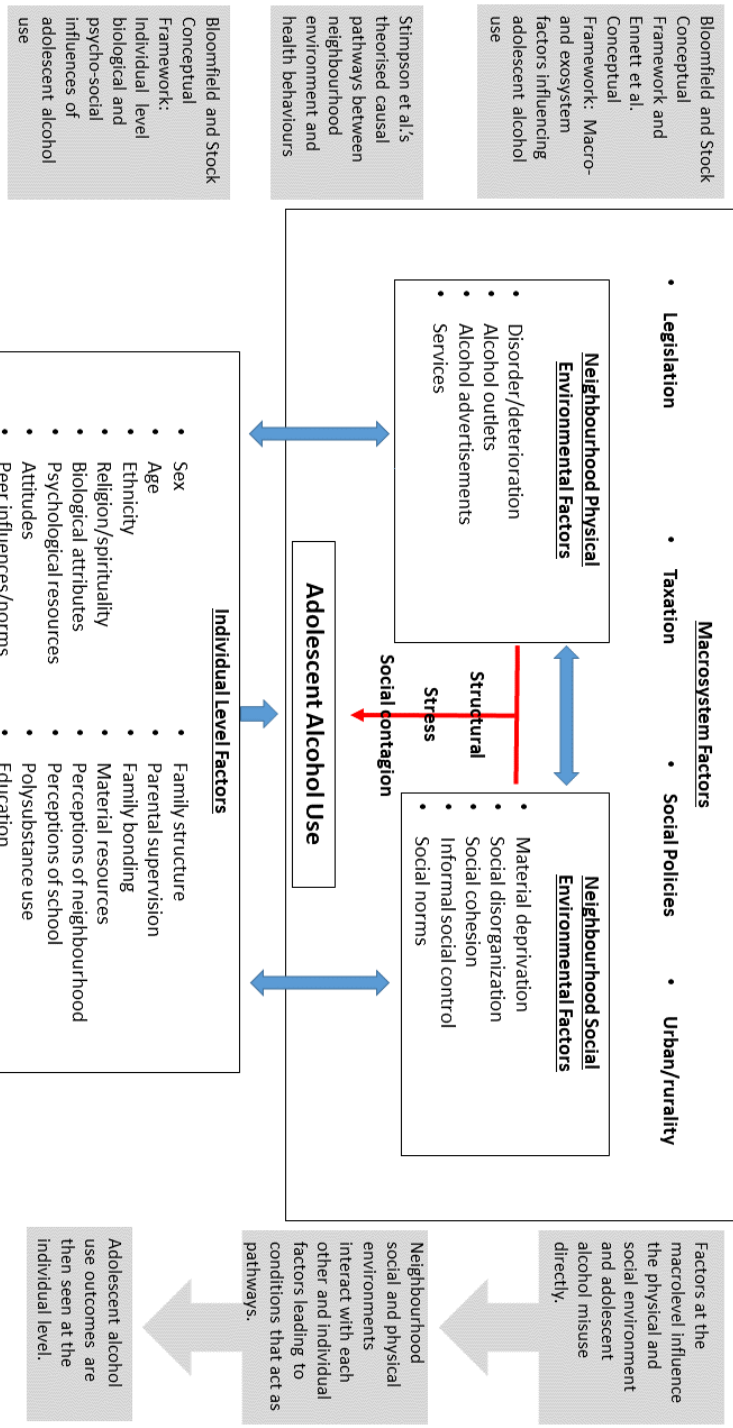

Figure 5.3: Conceptual model of neighbourhood influences on adolescent alcohol use

5.8 Summary

Multiple theories exist linking adolescent behaviours with neighbourhood characteristics. Furthermore, these theories have been extended to look specifically at adolescent substance use. By combining these theories and drawing on hypothesised causal pathways, a conceptual framework was developed to guide the research in this dissertation. Based on data availability the neighbourhood characteristics that are explored empirically in this research are limited to: neighbourhood disorder, neighbourhood social cohesion, alcohol outlets, and material deprivation. Urban/rurality is also considered as an important macro-level factor. Due to the difficulty in defining the social neighbourhood characteristics, a systematic review was conducted to better frame these concepts within the scope of this research. This is described in greater detail in Chapter 5.

Chapter 6

Methods

6.1 Introduction

The increasing interest in the role of the environment on human well-being has led to a growing number of health surveys (questionnaires) including locational questions (i.e. asking for respondent's street address or postcode) to better understand these relationships. The locational data can then be geocoded (translating the postal address to latitude and longitude coordinates) thus linking the respondent's responses to geographical space. This allows for 1) the aggregation of individuals' responses to regional areas and 2) the linking of existing geographic information to augment survey data. The former facilitates the classification of regional information for monitoring and comparison. The latter allows for a richer picture of the survey respondent's lived experience and a greater breadth of inquiry becomes available to researchers. This thesis utilises these data to investigate the influence of the neighbourhood environment on adolescent drinking behaviours and motivations. In this Chapter the data used in these analyses are described, followed by an outline of the statistical methods utilised.

6.2 Data

This research utilises secondary data, based on two data types: 1) survey and 2) administrative. Both survey and administrative data have benefits and limitations. Administrative data are collected by governments or other organisations often for purposes other than research. These data benefit by being based on large sample sizes, the collection is not intrusive to the population under study, and data are often reliable at the small area level. However, the researcher has no control over the content of the data (Administrative Data Liaison Service, 2010). On the other hand, survey data, which is usually collected on a sample of the population, can examine phenomena of interest to researchers that are not routinely collected. However, this data may be subject to bias and measurement error (Nieuwenhuijsen, 2005). By combining the two data types via data linkage, research questions can be addressed that are not possible using either data type on its own. The type of linkage undertaken in this research is between individual level survey data and contextual information based on administrative data.

6.2.1 Variable inclusion

Selection of variables for analysis was guided by theory about the relationship between neighbourhood factors and adolescent alcohol use, as discussed in Chapter 3. Basic demographics were included as control variables in statistical models. Care was taken to not include covariates that may conceivably be in the pathway between neighbourhood conditions and the drinking outcomes, such as family support, to avoid over-controlling. Including variables that are on the pathway (mediate) between the more distal neighbourhood conditions on alcohol outcomes may reduce the effect or make it appear that no such effect exists, when in fact the variable represents an explanatory component of the relationship (Shankardass and Dunn, 2012; Jackson et al., 2014). Alcohol use variables were selected based on data availability and theory as outlined in section 6.2.2.3.

6.2.2 Survey data

The survey data presented in this thesis were collected as part of the 2009/2010 Scottish component of the WHO HBSC cross-national study. This is a cross-sectional survey conducted every four years in over 40 countries across Europe and North America. In Scotland the sample was stratified by education authority and school type (state or independent) and a nationally representative sample was obtained using systematic random sampling (Currie et al., 2008). Parental consent was passive. Three school year groups of pupils were sampled from Primary 7 (approximately aged 11-12 years), Secondary 2 (approximately aged 13-14 years) and Secondary 4 (approximately aged 15-16 years). Only Secondary 4 (S4) data were used in this research because of availability of drinking motives questions and urban/rural indicators. The questionnaire was completed in class, under teacher supervision and was anonymous. The research protocol was approved by the University of Edinburgh's School of Education Ethics Committee.

The 2009/2010 S4 HBSC sample included a boosted sample of rural and small town schools allowing for comparisons at various levels of urban/rurality (Levin et al., 2014). This is important for studies examining neighbourhood effects as urban/rurality may be directly influential and may have modifying effects on neighbourhood processes. Schools in the boosted sample were randomly selected within each sampling frame, defined by an urban/rural classification, which was assigned by school postcode. A goal of 300 students was set for each of the Scottish Government's non-urban classifications. However, this was not achieved for all non-urban classifications (Levin et al., 2014).

Respondents of the HBSC survey reported their residential postcode. This information was not present in the data file that is publicly available. Ethical approval for the use and handling of the postcode data was provided by University of St Andrews University Teaching and Research Ethics Committee (UTREC)(reference number: MD11023- see Appendix D). Using the postcode, it was possible to geocode each adolescent and to therefore link each survey respondent to administrative data. Post-

codes are the smallest geographic unit in Scotland. On average there are 15 delivery points (an individual address or a group of delivery points) per postcode; but the range can be from 1 to 100 (`http://www.nrscotland.gov.uk/files/geography/Products/postcode-bkgrd-info.pdf`). Scottish data zones (DZ) and intermediate data zones (IDZ) are higher levels of geography which contain multiple postcodes. DZs (of which there are 6,505) have on average 750 residents. IDZs are built up from data zones, representing 1235 regions in Scotland, containing on average 4000 residents. IDZs were developed based on administrative data and local knowledge (Flowerdew et al., 2004). When linking in alcohol outlet densities (AOD), urban/rurality and neighbourhood deprivation, the finest geographic resolution available was used to achieve the most detailed estimate.

6.2.2.1 Data cleaning and preparation

Survey data were cleaned post data entry by researchers at the Child and Adolescent Health Research Unit at the University of Edinburgh in accordance with HBSC International Study Protocol guidelines (Currie et al., 2015; Griebler et al., 2010).

6.2.2.2 Missing data

Prior to conducting analyses, it was important to consider missing data and the potential impact these have on analyses. Missing data on demographics and outcome variables represented less than one percent of all the sample. Individual item responses in the composite scales: social cohesion, neighbourhood disorder, and drinking motives were imputed using the person average of available items in each scale, if less than half were missing (Katz, 2006). For the Family Affluence Scale (FAS) tertiles the imputation of a missing value was conducted on each variable with the mode of the items in the computed variable (IBM Knowledge Centre, 2018). This procedure has been used in past studies (Levin et al., 2014).

Missing postcode data It is a common procedure in studies of the neighbourhood environment that study participants with missing locational data are removed from further analyses. This leaves the researcher with a database with a fairly high level of accuracy, however many records may be lost (Hibbert et al., 2009). It has been identified as a limitation in such studies that a high number of study participants are often missing geographic data (Exeter et al., 2015; NHS Scotland, 2014), thus potentially introducing bias into analyses. Missing geographic data may be a greater issue in survey data, compared to administrative data, as people may choose to omit their address, or in the case of research with young people, the information may be unknown. For example the Scottish Schools Adolescent Lifestyle and Substance Use Survey (SALSUS) 2013 found 37 percent of respondents did not provide a valid postcode (NHS Scotland, 2014). It has been proposed that rather than excluding cases with missing data, geographic information can be imputed based on available information (Hibbert et al., 2009; Walter and Rose, 2013). This practice has become more common in epidemiological studies (Hibbert et al., 2009). Developing methods that impute missing spatial data has been identified as an important area of future research due to the possibility of improving these studies by increasing the number of participants included in main analyses (Exeter et al., 2015).

Two types of imputation were considered:

1) Imputing postcode based on a random individual within the same class, or

2) Using geo-imputation techniques that used ancillary data (school location as well as time and transportation method to get to school) to assign location

Method 1: Imputing postcode based on a random individual within the same class is the method used by the SALSUS 2013 survey. In this method cases that have a missing, incomplete or inaccurate postcode would be assigned the postcode of another respondent at random, given that the pupils were in the same class (NHS Scotland, 2014).

Method 2: To achieve geo-imputation, an 'areal interpolation' can be used when other spatial data are present. Areal interpolation represents a set of techniques that can be used to assign values from one areal unit to another, using ancillary information i.e., proportion of land area lying in units (area-weighted) or population proportion lying in units (population-weighted) (Flowerdew and Green, 1993; Hibbert et al., 2009). This provides a technique for researchers to assign individuals to units that are applicable to their research questions.

Further work was undertaken with the HBSC dataset before deciding which approach to use. The strategy examined using geo-imputation which involved assigning non-geocoded residential addresses to a Census Output Area (OA) based on their geocoded school location and using a weighted probability according to the spatial distribution of the underlying population of the OA. OAs were used as they represent the lowest level of geography for which an underlying population was available. These spatial units were created by aggregating a small number of postcodes and, similar to postcodes, higher levels of geography have been built up from OAs (Curriero et al., 2010).

The process was designed as follows: First, each individual with a missing postcode was allocated to a region around their school (Zone A), based on their time and mode of transport to school (as reported in the HBSC survey). Using this information each student was assigned to an OA based on the underlying population (15-17 years of age) from the 2011 census (figure 6.1).

If a student reported that they used motorised transportation buffers were derived surrounding each school using a Network Analyst file derived from the UK Ordinance Survey MasterMap® Integrated Transport Network (ITN)^{TM} Layer using Productivity Suite in ArcMap. Areas were calculated for each school location using cut-offs for travel time to school from the HBSC survey (5, 15, 30 and 60 minutes). Zone A was defined by these polygons (spatial regions). Alternatively, if a student walked to school, Zone A was

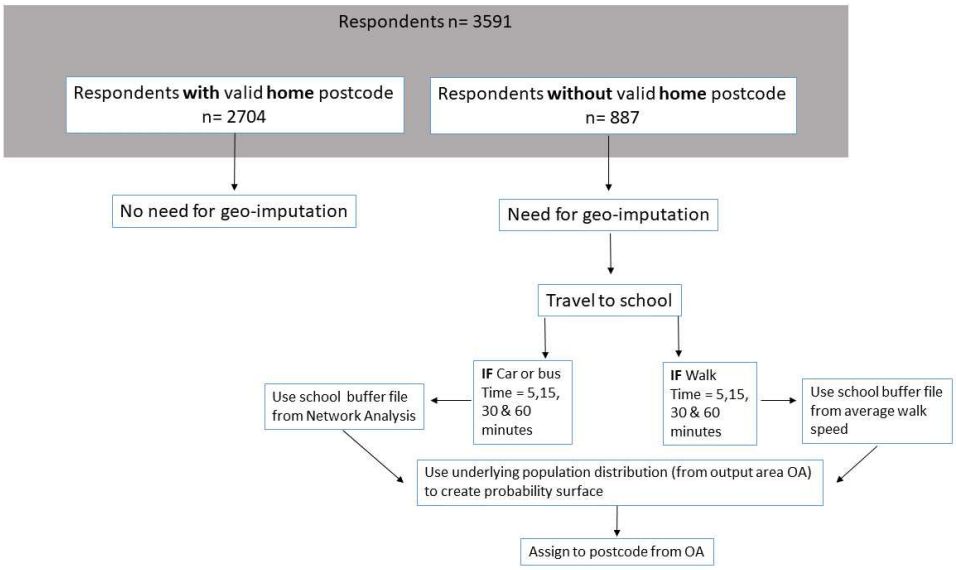

Figure 6.1: Flow diagram of geoimputation process

based on polygons derived from a walking speed of 80 meters per minute (Colabianchi et al., 2007) and reported travel time to school (5, 15, 30 and 60 minutes). This yielded polygons that are bounded by 400m, 1200m, 2400m and 4800m surrounding each school.

However, after examining both approaches (random assignment and geo-imputation), by checking how many correct postcodes were achievable within a sample of students with their postcodes removed, both methods indicated issues with accuracy. Specifically, from a random selection of 600 cases that were stripped of postcode data, only 34 cases (6 percent) could be assigned correctly even before random assignment using method 1. Using method 2 (geo-imputation), only 216/600 (36 percent) could be assigned correctly before assignment to an OA (correct postcode was in Zone A). Due to this low accuracy it was decided that, like other studies (Shortt et al., 2015), students with missing postcode data (887 of 3591 students) would be removed from analysis.

6.2.2.3 Survey data on outcome variables

Alcohol consumption and drinking motivations were examined as the main outcomes in this study.

Alcohol consumption is often measured in surveys. Issues with under-reporting have been well documented in adult population surveys. This has been determined by comparing alcohol sales to survey estimates (Stockwell et al., 2004). This approach is not viable to explore the validity of survey questions designed for adolescents. A review by (Brener et al., 2003) examined other approaches, such as test-retest or bio-chemical test, to determine the validity of alcohol and other substance use questions for adolescents. For adolescent alcohol use, test-retest results suggest high levels of reliability. However, alcohol does not lend itself to comparison to bio-chemical tests because of the short time frame in which the test must be taken. Brener et al. (2003) highlight that "problems in the retrieval of the required information can occur because behaviours have to be both recalled and placed within the appropriate time period" (p. 438). They conclude that a short time period for which the recall takes place yields more valid results. In the HBSC survey a compromise is made between keeping questions consistent to previous years for monitoring purposes and including more up-to-date measurement standards (Currie et al., 2001).

Using multiple measures of alcohol use allows for different patterns of consumptions to be evaluated. Like other studies of substance use among adolescents several outcomes were used (Levin et al., 2014; Walsh et al., 2014; Archimi and Kuntsche, 2014; Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016), as discussed below. All measures have shown convergent validity (Griebler et al., 2010)

6.2.2.4 Measurement of alcohol consumption

Ever drank Having ever drank was identified as those who reported an age at which they first drank alcohol (more than a small amount) (Never/ 11 years old or less/ 12

years old/ 13 years old/ 14 years old/ 15 years old/ 16 years old). Pupils were instructed to select 'never' if drinking was something they had not done.

Weekly drinking Weekly drinking was calculated by the following question: 'at present how often do you drink anything alcoholic, such as beer, wine or spirits? Try to include even those times when you only drink a small amount.' Beer or lager/Wine or champagne/Alcopops (like Smirnoff Ice, Bacardi Breezer, WKD)/ Spirits (like whisky, vodka)/ Cider/Fortified (strong) wine like sherry, martini, port, Buckfast/Any other drink that contains alcohol. (Every day/ Every week/ Every month/ Hardly ever/ Never). Those who reported drinking any of these beverages daily or weekly were classified as weekly drinkers.

Drunkenness Drunkenness was assessed with the following question: 'Have you ever had so much alcohol that you were really drunk?' (Never/ Once/ 2–3 times/ 4–10 times/More than 10 times). This was dichotomised into: less than twice or twice or more.

6.2.2.5 Measurement of drinking motives

Four common motives appear in the literature examining young people and drinking motives, these are most commonly referred to as: 1) coping, 2) enhancement, 3) social and 4) conformity motivations. These four motives are measured and have been validated when using a four factor Drinking Motives Questionnaire, known as the DMQ-R (Drinking Motives Questionnaire) developed by Cooper (1994). A short form of this questionnaire was developed and validated by Kuntsche and Kuntsche (2009). In this revised version each of the four dimensions are measured using the average of three items assessed on a 5-point Likert scale (almost) never/some of the time/ about half of the time/most of the time / (almost) always. This questionnaire has been validated for use in the HBSC Survey in previous research (Kuntsche et al., 2014). Only students

who had consumed alcohol in the past year answered the questions on drinking motives.

Conformity Conformity motivation was measured with the following questions: In the last 12 months, how often did you drink... 1) To fit in with a group you like? 2) To be liked? 3) So you won't feel left out?

Coping Coping motivation was measured with the following questions: In the last 12 months, how often did you drink... 1) Because it helps you when you feel depressed or nervous? 2) To cheer up when you're in a bad mood? 3) To forget about your problems?

Enhancement Enhancement motivation was measured with the following questions: In the last 12 months, how often did you drink... 1) Because you like the feeling? 2) To get high? 3) Because it's fun?

Social Social motivation was measured with the following questions: In the last 12 months, how often did you drink... 1) Because it helps you enjoy a party? 2) Because it makes social gatherings more fun? 3) Because it improves parties and celebrations?

6.2.2.6 Survey data on individual characteristics

Sex Sex was included based on self-report of the question: are you a boy or a girl? The question was confined to more rigid ideas of biology (boy or girl) – rather than the more fluid cultural and societal concepts regarding gender norms or individual gender identities. Although, it was based on self-report, so it may be answered based on self-identification rather than birth assignment.

Age Although all students were in S4 and approximately the same age even small age differences could impact behaviour given the vast number of biological and social changes that occur during this time. Therefore, age was included in some analysis based on year and month of birth.

Ethnicity Ethnicity has been found to impact on adolescent alcohol use (Rodham et al., 2005). Respondents reported the ethnic background(s) they identified as from a list that included: Bangladeshi, Black-African, Black-Caribbean, Black-Other, Chinese, Indian, Pakistani, White, and Other. This was dichotomised into a variable of 1) white (if only white was selected) or 2) other, due to there being a small number of individuals who identified as non-white.

Family structure Family structure has been shown to associate with adolescent drinking outcomes (Bjarnason et al., 2003). Following classifications from Rüütel et al. (2014) and similar to Levin and Currie (2010) adolescent family structure was classified as living in a family with 1) both parents, 2) living in a single parent (father or mother) household, or 3) Other (living with a step-parent, grandmother, grandfather, foster/children's home, 'someone or somewhere else'). Most of those in this group were those in step-parent families, but due to a small number of students reporting other family situations, these two categories were collapsed.

Family affluence There has been mixed evidence regarding the role of family affluence and adolescent drinking behaviours (Richter et al., 2009; Obradors-Rial et al., 2018). Family affluence was measured using a composite scale (Currie et al., 2008). Responses to the following questions were scored and combined to give a sum score of family affluence: Does your family have a car or van? (no/ one/ two or more), do you have your own bedroom to yourself? (no/ yes), during the past 12 months, how many times did you travel away on holiday with your family? (not at all/once/twice or more) and how many computers (PCs, Macs or laptops) does your family own? (none/one/two/more than two). Categorical principal components analysis was used to create tertile groups of family affluence using SPSS syntax that was previously developed for use with the Scottish HBSC data, using CATPCA in SPSS, as recommended by Batista-Foguet et al. (2004).

6.2.2.7 Survey data on neighbourhood characteristics

There is still much debate as to whether neighbourhood social factors are individual attributes or collective features (Kawachi et al., 2004; Poortinga, 2006). Where possible, examining both collective measures and individual perceptions are desirable. This allows for the most complete picture of the role neighbourhood social environment. It is important that studies make clear whether associations are found at the individual or collective level as these indicate levels of potential policies and targets for interventions i.e., people or places (Gilbert et al., 2013; Poortinga, 2006). The HBSC survey has several questions regarding social characteristics of the local area where the survey respondent resides (see table 6.1). These represent a set of indicators of neighbourhood conditions that were previously developed by the HBSC international network, a multinational group of experts in the field of adolescent health. Prior to data collection the neighbourhood conditions questions were piloted in several countries including Scotland to ensure adolescents understand the meaning of the questions (Currie et al., 2001). The goal of many of these survey items, was to measure neighbourhood social conditions, specifically for young people, drawing on multiple theoretical perspectives (Morgan, 2011). They were based partially on social capital measures used by Kawachi et al. (1997) and on qualitative analysis undertaken by Morrow (2001). Other items addressing neighbourhood conditions were included in the current analysis regarding general perceptions of the neighbourhood and presence of certain behaviours and physical features (i.e., rundown buildings).

6.2.2.8 Individual level perceived social environment

As a first step individual measures were examined. Psychometric methods were used to group, validate, and measure reliability of the individual level scale measures. One item regarding the local area was not included in this analysis: "How well off is the area in which you live?" This exclusion was made because this item assessed economic

Table 6.1: HBSC questions regarding neighbourhood perceptions

Question	**Value Range**
Feel safe in local area	1 “always” - 4 “rarely or never”
Local area is a good place to live	1 “yes, it is really good”-5 “no, it is not good at all”
In the area where you live you can trust people around here	1 “agree a lot” – 5 “disagree a lot”
People say ‘hello’ and talk to each other in the streets in the area where you live	1 “agree a lot” – 5 “disagree a lot”
It is safe for younger children to play outside in the area where you live	1 “agree a lot” – 5 “disagree a lot”
There are good places to spend free time in the area where you live	1 “agree a lot” – 5 “disagree a lot”
I could ask for help or favour from a neighbour in the area where you live	1 “agree a lot” – 5 “disagree a lot”
Most people around here would try to take advantage of you if they got a chance in the area where you live	1 “agree a lot” – 5 “disagree a lot”
In the area where you live there are groups of young people who cause trouble	1 “lots”- 3 “none”
In the area where you live there are litter, broken glass or rubbish lying around	1 “lots”- 3 “none”
In the area where you live there are run-down houses or buildings	1 “lots”- 3 “none”
How well off is the area in which you live?	1 “not at all well off” – 5 “very well off”

conditions rather than social environment. It did not, therefore, fit theoretically with the other items. These items have been used in multiple past studies either in their entirety, or using a subset (i.e., Nichol et al., 2010; De Clercq et al., 2012; Vafaei et al., 2014). Items were recoded so that higher values indicated greater presence of each item. This is addressed in greater detail in Chapter 7.

6.2.2.9 Neighbourhood level social environment

When calculating neighbourhood measures (aggregating individual measures to a shared geographic unit) from items or scales there are several options. This section outlines three approaches and seeks to compare them (see table 6.2). The construction of these measures is discussed in more detail in Chapter 7.

A) Direct aggregation Direct aggregation (calculating the mean of items within an area) is a common procedure used in past studies of neighbourhood level social measures (Aminzadeh et al., 2013; Åslund and Nilsson, 2013; Kuipers et al., 2012; Murphy et al., 2014; Takakura et al., 2014). This approach is straightforward. First, an aggregate spatial unit is selected. Second, a cut-off 'n' is established per unit (i.e., 5 people per unit), unless a large sample is achieved for each unit, and any unit falling below the cut-off is dropped from the analysis. Finally, the mean (or another summary statistic) of the item or scale is calculated within each unit. Few studies that use this method report any attempt to assess the validity or reliability of the neighbourhood measure (see Åslund and Nilsson, 2013). One exception is Aminzadeh et al. (2013) who used the approach of dividing neighbourhood variance by the sum of all neighbourhood variance and individual variance divided by group size, to validate their measure of adolescent neighbourhood social capital. However, the results are difficult to interpret in terms of reliability. Limitations of this method include: 1) the cut-off selection is somewhat arbitrary, 2) there is a trade-off between maintaining a high number of geographical units

and the potential for unstable estimates due to small numbers, 3) the unit of analysis is often selected based on administrative units which may not reflect the underlying sense of neighbourhood by the participants, 4) individual characteristics may influence perceptions (Mohnen et al., 2014), and 5) the number of respondents and the reliability of the measure differs per unit which is not taken into account in this approach (Mohnen et al., 2011). The major strength of this approach is that it is simple to calculate and communicate.

B) Ecometrics An alternative to direct aggregation is ecometrics. This approach uses a three level multilevel model where one level is for neighbourhoods, another is for individuals, and the last is the items of the neighbourhood measure (Mohnen et al., 2011). It was first devised by Raudenbush and Sampson (1999) to obtain more complete information regarding the social environment from surveys. This approach extends beyond the psychometric properties of the individual to the ecological properties of the collective. Interrater agreement is measured by an intra-neighbourhood reliability measure which is interpreted similarly to Cronbach's alpha (Hox, 2002). Many recent studies examining the social environment have used this approach (Bjornstrom et al., 2013; Mohnen et al., 2014). Often the standardized residuals are used as a measure of each neighbourhood (Bjornstrom et al., 2013). Limitations of this method include: 1) a cut-off n is still required and 2) like direct aggregation, the unit of analysis is often based on administrative units and is somewhat arbitrary. The strengths of this method are that: 1) covariates that may influence the measure can be adjusted for, 2) shrinkage towards the general average occurs in estimates of units with a smaller number of respondents which accounts for differing numbers of individuals per unit (Mohnen et al., 2014) and 3) reliability can be tested (Hox, 2002).

C) Spatial interpolation Recently, attention has been given to alternative approaches that utilize the spatial structure of health survey data (Meng et al., 2010).

Spatial interpolation takes the values at known areas and interpolates a value to unknown areas. This approach has only been recently used in health studies but has a long history in geo-statistics. There are multiple methods that can be used in spatial interpolation such as inverse distance weighting (IDW) or kriging; both have several variations within each approach. IDW uses the surrounding values to interpolate while kriging also incorporates weights based on distance. Kriging also provides some measure of the certainty of predictions. Meng et al. (2010) used this approach to derive small area estimates from the Canadian Community Health Survey on items such as sense of belonging to the community. This approach has also been used on measures of systematic assessment by researchers examining neighbourhood disorder in Detroit (Keyes et al., 2012). Once interpolation has been conducted, the interpolated surface can be aggregated to any small area neighbourhood unit that is chosen by the researcher. The strengths of this approach include: 1) its usefulness in longitudinal studies where boundaries may change, 2) it does not require a cut-off n as it uses all available data points, and 3) administrative units are not used in deriving the surface. The limitations include: 1) it is not possible to test reliability of multiple items within a scale (the scale is defined at the individual level prior to interpolation), 2) many decision points regarding bandwidth (i.e., k nearest neighbours or distance) need to be tested and 3) error will be high in sparsely sampled areas (this leads to additional questions: should these high error areas be included and, if not, what is an appropriate cut-off?).

Rationale of method selection Because this PhD research sought to use multi-item scales in measuring the social neighbourhood environment that adolescents are exposed to, a method of aggregation needed to be selected. Ecometric methods were used to validate and measure reliability at the neighbourhood level. An ecometric approach was chosen as the most appropriate because the scales were based on multiple items and this approach allows for the reliability of the scale items to be quantified at the

Table 6.2: A comparison of methods for deriving neighbourhood measures

Method	Strengths	Limitations	Key Citations
Direct Aggregation	Easy to calculate	Arbitrary cut-off selection of n per unit Requires a trade-off between maintaining a high number of units and the potential for unstable estimates The unit of analysis is often arbitrary Does not account for individual characteristics Reliability is difficult to calculate	NA
Ecometrics	Reliability can be tested Covariates can be adjusted for Accounts for differing numbers of individuals per unit	Arbitrary cut-off selection of n per unit Requires a trade-off between maintaining a high number of units and the potential for unstable estimates The unit of analysis is often arbitrary	Raudenbush and Sampson (1999) Hox (2002)
Spatial Interpolation	Useful in longitudinal studies Does not require a cut-off Does not rely on previously defined units	Error will be high on sparsely populated areas Cannot test the reliability of multiple scale items	Meng et al. (2010)

neighbourhood level. IDZs were used to define neighbourhoods for the neighbourhood level social environment measures as the lower levels of geography did not have many respondents within them. The ecometric method is outlined in greater detail in Chapter 7 .

6.2.3 Administrative data

Administrative data were retrieved from various government and academic sources.

1. The Scottish Neighbourhood Statistics website provided a postcode translation file that matched adolescents' residential postcodes to administrative geographic boundaries (data zones and intermediate data zones), indicators of urban/ rurality, and neighbourhood deprivation.

2. All students sampled in the HBSC S4 survey, who had valid postcodes, were geocoded to their latitudinal and longitudinal coordinates using National Statistics Postcode Look-up (NSPL) from EDINA (`http://census.edina.ac.uk/`).

3. Availability of liquor stores was calculated by researchers at the Centre for Research on Environment, Society and Health (CRESH) using data from Liquor Licensing Boards.

Urban/rural classifications Urban/rurality of the Scottish sample was classified into 6 categorises based on the urban-rural classifications by the Scottish Government:

- Cites (Settlements with population over, 125,000: Aberdeen, Dundee, Glasgow, and Edinburgh)

- Other urban (other settlements with a population equal or over 10,000)

- Accessible towns (settlements with a population between 3,000-9,999 and within a 30 min. drive time of a settlement of 10,000 or more)

- Remote towns (settlements with a population between 3,000-9,999 and more than a 30 min. drive time of a settlement of 10,000 or more

- Accessible rural (settlements with a population less than 3,000 and within a 30 min. drive time of a settlement of 10,000 or more)

- Remote rural (settlements with a population less than 3,000 and more than a 30 min. drive time of a settlement of 10,000 or more)

Unlike many other studies that examine urban/rurality and its role in alcohol consumption, a six-category classification system was used to allow for a more fine-grained analysis than simple urban versus rural classifications (Dixon and Chartier, 2016). The classification was made at the finest geographic unit available to get the most detailed measurement. Therefore, respondents' home postcodes were classified into urban/rurality categories. This was a possibility due to the oversampling strategy of the 2009/2010 HBSC which represents a strength of this study.

Index of Multiple Deprivation Data on neighbourhood socioeconomic conditions was determined by the Scottish Index of Multiple Deprivation (SIMD) 2012 and linked by each respondent's home postcode. This measure was calculated by data zones. The measure has seven domains: employment, income, health, education, access to services, housing, and crime. For this study, only the income domain (based on quintiles) was used to determine level of neighbourhood deprivation as this is most representative of socioeconomic conditions. This is in line with past studies (Walsh et al., 2010; Shortt et al., 2015). Additionally, other domains such as access to services may be strongly related to rurality (Levin et al., 2014).

Alcohol Outlet Density All premises that sell alcohol in Scotland are required to be licensed under the Licensing (Scotland) Act 2005. Researchers at CRESH obtained the addresses of all outlets that held a license to sell alcohol in 2012 from 36 local Liquor Licensing Boards and, using this data, created a measure of outlet density for each postcode and data zone using Kernel Density Estimation (KDE). This process divides Scotland into 100x100 metre grid cells and assesses the number and proximity of outlets within an 800-metre radius for each cell. Sensitivity analysis was conducted using 400 and 1000 metre radii. This radius was chosen as a plausible walking distance to get to an outlet and has been used in both tobacco and alcohol studies (Shortt et al., 2015, 2018). Outlets nearer the centre of the search window have greater weight than those further

away therefore the KDE value represents a proximity-weighted estimate of the density of each outlet type per km2 on the grid. KDE for spatial point location data produces a smooth, continuous geographic surface for which every location in the study area has assigned a value which can then be used as an independent or dependent variable in statistical models (Carlos et al., 2010). The density of points is calculated using a pre-specified cell size, a kernel function, and a bandwidth (a circle with a radius centred on the focal location) such that the surface is highest above the case (outlet location) and zero at the specified bandwidth from the outlet. The centre of this cell size receives the density value (Chang, 2006). It is important to note that increasing the bandwidth produces a greater smoothing effect (the surface becomes more generalised by reducing both the number and magnitude of local maxima) from the original data distribution. The selection of a bandwidth distance that is too large or too small, may over or under-smooth the data (Carlos et al., 2010; Chainey, 2013). Therefore, sensitivity analysis represents an important step. Alcohol outlet density has been previously examined using KDE (see Carlos et al., 2010). It is argued that KDE is not subject to modifiable areal unit problem (MAUP) (Carlos et al., 2010). However, Chainey (2013) found that choice of cell size does not make a substantial difference to study results while bandwidth choice did.

A second approach was also investigated that used a simple proximity to alcohol outlet based on point locations of alcohol outlets (from postcode) of each student. The distance along the road network to closest outlet was calculated and used in this measure. This was done in a manner similar to Young et al. (2012) who found proximity was associated with adolescent drinking in Glasgow. However, under further examination this measure yielded some zero values (no distance between the pupils home and an alcohol outlet) in areas with few postcodes as both the adolescent and the outlet shared the same postcode; this occurred largely in non-urban areas. Therefore, proximity measures that use postcode for geocoding both the source and destination may

not be appropriate for rural samples. Due to this, the above measure was not used in analyses and the KDE method was used in this study.

The data were classified as on-premise outlets (i.e., bars or restaurants) and off-premise outlets, where alcohol is consumed elsewhere (i.e., shops). This data had been used in previous studies that have shown a greater density of alcohol outlets was present in the most deprived areas (Shortt et al., 2015) making this an important covariate in studies of neighbourhood effects on alcohol consumption outcomes.

6.3 Statistical analysis

The research presented here uses several statistical modelling approaches to validate neighbourhood social environment measures and estimate the associations of neighbourhood characteristics with drinking behaviours and motivations. Broadly, the two main approaches used are multilevel modelling and structural equation modelling. These two approaches are introduced below as well as several analytical considerations that are considered throughout this research. Where drinking behaviours are the outcome a logistic regression model was specified and when motivations are the outcome a linear regression model was used. More specific information on each method is given in the subsequent Chapters 7 through 9.

6.3.1 Multilevel modelling

The research presented here is based on multilevel modelling techniques. These techniques are used to calculate neighbourhood-level measures using ecometrics (as detailed earlier in this Chapter and in Chapter 7). Additionally, multilevel models are used to examine the relationships between neighbourhood characteristics and adolescent drinking outcomes (detailed in Chapters 8 and 9). Multilevel modelling extends ordinary linear regression in that respondents are clustered in higher level groupings (i.e., neighbourhoods, schools, families, etc.), allowing for residual components at each level, and

thus accounting for correlation between individuals in the same grouping. Because the individuals within a group may be more alike than those out with the group, the assumption of linear regression that individuals are independent are not met; therefore, to avoid underestimated standard errors multilevel models can be used. Multilevel modelling also allows for examination of the impact of higher level groupings on the outcome variable (Robson and Pevalin, 2015). All multilevel models were conducted using the Stata command runmlwin (Leckie and Charlton, 2013) which runs models through the software MLwiN from within Stata.

6.3.1.1 Assumptions

Linear multiple regression has four main assumptions that should be examined. 1) Normality- errors (residuals) should be normally distributed; however, this assumption is not required if other assumptions are met (Williams et al., 2013). 2) Linearity - the outcome is linearly related to the predictor variables. 3) Homoscedasdicity- equality of variances, and 4) Independence of observations. When conducting logistic regressions meeting the assumptions of linear relationships are not of concern. However, the assumption of independence of errors still hold; additionally, there should be a linear relationship between continuous independent variables and their log-transformed outcome (Stoltzfus, 2011). Multicolinearity (high correlation between predictor variables) is also a concern. When doing multilevel modelling the process of diagnostic checking is largely the same as with ordinary least squares or logistic regression (Robson and Pevalin, 2015). Residuals are tested for normality (Robson and Pevalin, 2015). Linearity is tested by plotting the residuals against the predicted values and examining for a pattern (Williams et al., 2013). Multicollinearity can be tested using variance inflation factors of the predictor variables.

Social epidemiology is increasingly incorporating spatial approaches. Many studies that examine neighbourhood effects using multilevel modelling utilise data that are

spatially structured, yet higher level groupings are treated as though they are independent and disconnected in space. However, locations that are near each other are more likely to be similar – a feature known as spatial autocorrelation – thus, not meeting the assumption of independence of observations. To examine whether unaccounted for spatial autocorrelation is an issue in the models, a global Moran's I was calculated on the IDZ residuals (Anselin and Griffith, 1988). Due to many IDZs used in this study being non-contiguous (not connected) (see figure 6.2, Euclidean inverse distance was used to define spatial weights between IDZs, as necessary for the global Moran's I statistic.

6.3.1.2 Cross-classified multilevel models

Within the HBSC survey design, students are clustered within schools but also cluster according to their residential neighbourhood. Neighbourhood characteristics are of principal interest for this study and the level of clustering accounted for in the multilevel models is based on that. Additionally, school clustering is also accounted for in some models to ensure that neighbourhood effects found are not actually unaccounted for school effects. This is done using cross-classified multilevel models. These models allow for the fact that students' neighbourhoods and schools are not necessarily nested i.e., the school not being within the neighbourhood (Robson and Pevalin, 2015). Figure 6.3 shows the structure of a multilevel model on the left-hand side, where pupils are nested in a neighbourhood, but school is not considered. In the cross-classified model, each pupil is associated with a school and neighbourhood, which are not necessarily nested. A single school could have students who reside in multiple neighbourhoods and students from the same neighbourhood may attend different schools

6.3.1.3 Markov Chain Monte Carlo estimation

To run models that test for associations of neighbourhood characteristics with drinking outcomes Markov Chain Monte Carlo (MCMC), using Bayesian inference was used.

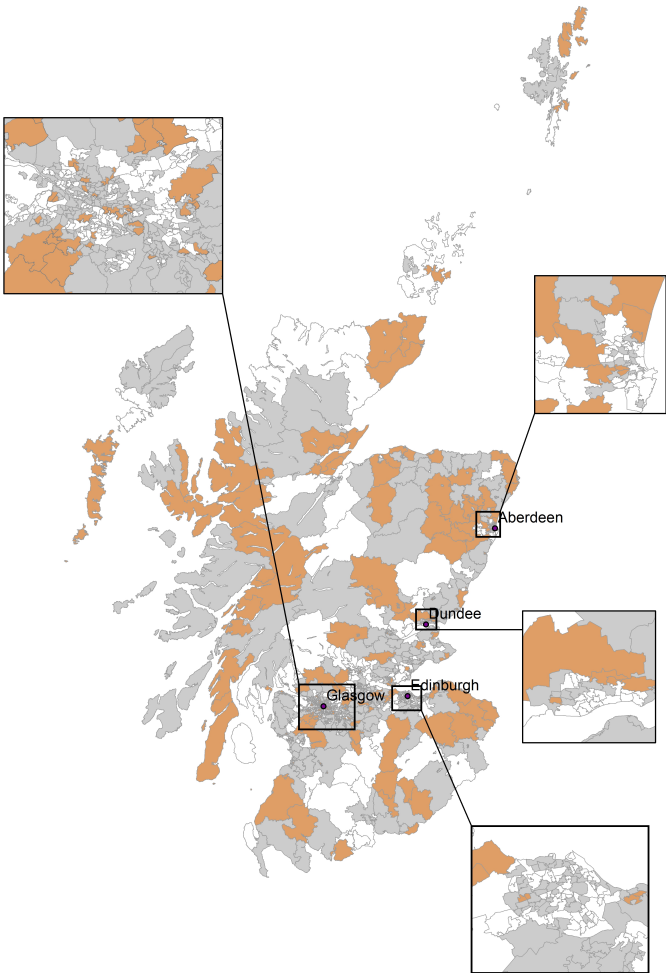

Figure 6.2: IDZs included in analysis (orange regions have > 5 respondents and are in all analysis, grey areas have < 5 respondents, and white have no data)

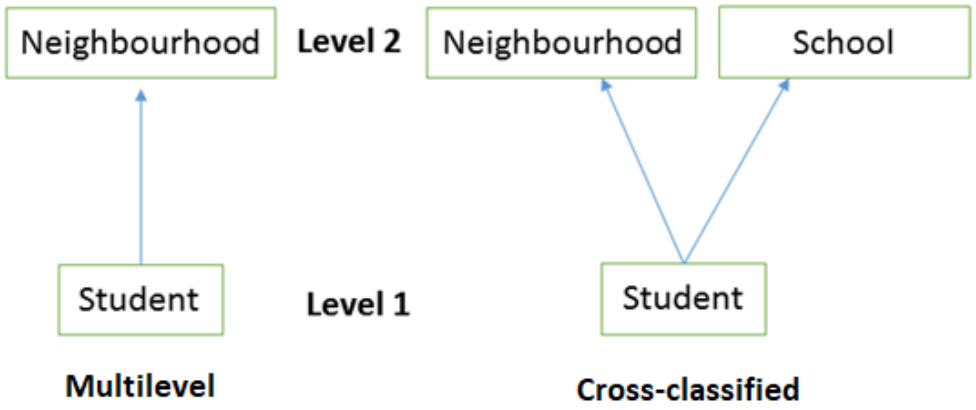

Figure 6.3: Comparison of multilevel and cross-classified multilevel models

The advantage of this approach is that it is well suited to more complex data structures (such as cross-classified models) and where there are a low number of individuals in higher levels of a multilevel model (De Clercq et al., 2014). The procedures do not produce point estimates, instead many iterations are run and for each evaluation a distribution is formed. From this accuracy interval estimates are produced, namely credible intervals. The mean of this distribution can be obtained and used as substitute for a point estimate. A p value can be derived and interpreted as the probability of the (null) hypothesis (Van de Schoot et al., 2014). A start value needs to be given for MCMC sampling. For this research the values were given using a least squares method (Leckie and Charlton, 2013).

Generally, the models take a while to 'settle down' (converge) so some iterations are omitted from the sample from which the summary values are drawn. This is called the burn-in (Browne, 2017). Like past research, a burn-in length of 5,000 was used (De Clercq et al., 2014). The number of iterations (chain length) needed to achieve model convergence was assessed by the Raftery-Lewis statistic and examining the trajectory plots (De Clercq et al., 2014). The Raftery-Lewis statistics gives the number

of iterations needed to be 95 percent confident that the error is smaller than 0.005 for the estimates at the 2.5th and 97.5th percentiles (Hox et al., 2010). In Bayesian inference every unknown parameter must have a prior distribution; diffuse priors (a relatively flat distribution) are used in this research due a lack of a priori knowledge of the distributions. These are the default in MLWin.

In models using MCMC the Bayesian Deviance information Criteria (DIC) is used to compare models. The DIC reflects fit of the model and penalises for increased complexity. A smaller DIC being more desirable. A difference of 5 is generally considered substantial (Khana et al., 2018; Spiegelhalter et al., 2002).

6.3.1.4 Interactions

Because there is reason to believe that urban/rural status and other neighbourhood characteristics may influence the relationships between the neighbourhood social environment and adolescent drinking, interaction (moderation) effects were examined. Aguinis et al. (2013) provide a set of guidelines for interactions with multilievel models. However, guidelines are not available for approaches that are using a Bayesian approach, which may be better suited to these more complex methods. In terms of sample size, a rule of thumb of 50 neighbourhoods, with a minimum of 20 respondents per neighbourhood has been suggested (Subramanian et al., 2003). However, many previous studies that conduct multilevel interaction analysis do not meet that cut-off (see Mathieu et al., 2012; Prins et al., 2014). Additionally, within group sample size may not be such a concern as a simulation study found that the magnitude of the interaction effect is an important factor in the statistical power of multilevel interaction analysis and that power is not simply a function of sample size (Mathieu et al., 2012).

Many texts recommend multilevel interactions be conducted by specifying the neighbourhood level variable as having a random slope (slopes can vary between groups) (Leckie, 2010*b*). However, other texts do not use this approach, not extending beyond

a random intercept model (only intercepts vary) (Robson and Pevalin, 2015). Both approaches have been used previous in public health research -see Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga (2016) for the former and Prins et al. (2014) for the latter. Allowing for random slopes would produce more accurate standard errors (Aguinis et al., 2013) but it is difficult to specify such a model in cases where there are a small number of individuals with higher level groupings. In this research both approaches were attempted; however, due to small numbers in neighbourhoods, which calls to question the validity of slopes, random intercept models are interpreted and random slope models are conducted to test the sensitivity of the models. This is discussed in greater detail in Chapter 8.

6.3.2 Structural equation modelling

Structural equation modelling (SEM) represents a set of multivariate methods that includes measurement models (i.e., confirmatory factor analysis), latent growth models, and path analysis (Geiser, 2012). SEMs are theory-based models, meaning that the theory is specified a priori and the model is used to test the theory. An advantage of SEM is that intervening (mediator) variables between independent and dependent variables can be included in models (Hox and Bechger, 1998). There are many goodness-of-fit indices that evaluate how well the model fits the data. It is good practice to use several in determining model fit. Three of these approaches are the Tucker-Lewis Index, the goodness of fit index (GFI), and the comparative fit index (CFI). If the model is a perfect fit to the data, the indices will equal 1. The rule of thumb is that a value of 0.95 or above for these measures, indicates acceptable to good model fit (Schermelleh-Engel et al., 2003). A Root Mean Square Error of Approximation (RMSEA) is another approach to assessing model fit. In this approach a smaller value (typically < 0.06) indicates that the given model approximates the 'true model' (Hox and Bechger, 1998). The SEM approaches that are used in this research are: confirmatory factor analysis (Chapter

7) and path analysis (Chapter 9). These approaches had the benefit of allowing for measurement invariance to be tested (CFA) and for allowing indirect effects (mediation) to be empirically tested. More details are provided in the respective Chapters regarding the type of models used.

6.4 Summary

This research utilises administrative and survey data. Considerable attention was given to deriving neighbourhood variables from existing survey data. Additionally, several statistical approaches were used. Using a variety of analysis techniques allowed for a better assessment of the role of the neighbourhood social environment in adolescent alcohol use.

Chapter 7

Assessing the psychometric and ecometric properties of neighbourhood scales using adolescent survey data from urban and rural Scotland

This chapter is partly based on the following work accepted for publication in Population Health Metrics

Martin, G., Inchley, J., Humphris, G. and Currie, C. (2017). Assessing the psychometric and ecometric properties of neighbourhood scales using adolescent survey data from urban and rural Scotland. Population Health Metrics 15(1),11.

7.1 Introduction

The impact of neighbourhood conditions on health and well-being outcomes has been gaining considerable attention over the past decade (Piccolo et al., 2015). Young people may be especially affected by the neighbourhood they live in due to their limited mobility restricting their school, family, and peers to a confined geographic area (Aminzadeh et al., 2013; Åslund and Nilsson, 2013). Not only have neighbourhood social conditions been examined as a predictor of adolescent alcohol use but many studies have also explored the impact of neighbourhood social conditions on other adolescent health outcomes including self-rated health (i.e., Aminzadeh et al., 2013) and violence (i.e., Vowell, 2007). In line with this increased research interest, there is a need for measurement instruments that examine the features of the neighbourhood, in order to better understand the relationships between the neighbourhood context and adolescent health and well-being (Moore et al., 2011; Oliva et al., 2012; Friche et al., 2013). Despite this, there are few validated and reliable measures of adolescent neighbourhood social conditions (Oliva et al., 2012), particularly at the neighbourhood level.

Most studies examining neighbourhood level conditions make use of structural measures which are based on administrative data, such as census information. Recently research has moved beyond examining the structural features of the neighbourhood to better understand the societal conditions present at the neighbourhood level. Survey data have proven to be a useful source in understanding the social conditions of the neighbourhoods in which people reside (Sampson et al., 2002; Friche et al., 2013). However, many studies rely on adult reports to understand the neighbourhoods in which adolescents live, leaving adolescents ignored as active agents within their own neighbourhoods (Morrow, 1999; Paiva et al., 2014). Schaefer-McDaniel (2004) argues that this represents a methodological flaw as adults might not represent with accuracy the experiences and perceptions of young people in their environment. As previously discussed this is because young people might have different perceptions of their neighbourhood

than adults, are exposed to fewer neighbourhoods to compare their own with, and access different areas of their neighbourhood in different ways (Martin, Gavine, Inchley and Currie, 2017).

Neighbourhoods are experienced through an individual's perceptions and as a collective attribute at an aggregate level (a shared characteristic). Where possible, examining both collective measures and individual perceptions is desirable to allow for the most complete picture of the role of neighbourhoods in adolescents' lives. Kawachi et al. (2004) argue that studies examining the relationship between neighbourhood social conditions and health should consider both individual perceptions and collective conditions using multilevel frameworks and considering cross-level interactions. For instance, socially isolated individuals may still benefit from residing within a community with positive neighbourhood conditions. The construction of valid and reliable measures that operate at both the individual and neighbourhood level necessitates an assessment of both psychometric and ecometric properties. Psychometric properties refer to the extent to which items reliably capture a construct at the individual level, while ecometric properties refer to the reliability at the neighbourhood level (Friche et al., 2013). Although some studies exist detailing the psychometric properties of adolescents' neighbourhood perceptions (i.e., Oliva et al., 2012) fewer studies examine the ecometric properties of these measures (Martin, Gavine, Inchley and Currie, 2017).

An important consideration when deriving neighbourhood scales that will be utilised in a variety of neighbourhood settings is whether the scale items are operationalised similarly for different types of regions, and what adaptations might be needed to ensure scales are appropriate across neighbourhood types. The same scales therefore may not be invariant between urban and rural areas (Evenson et al., 2009). Neighbourhood scales are considered invariant when items within the scale function similarly between different groups i.e., those living in different areas, see Choi et al. (2006); Karcher and Sass (2010) for a more complete discussion. This makes comparisons between groups

justifiable. Two types of invariance are most frequently considered 1) factor loading invariance (metric invariance) and 2) intercept invariance (structural invariance). Metric invariance indicates the factor loadings are equal across groups; if this condition is met, "weak" invariance is satisfied (Tucker et al., 2006). Reasons metric invariance may not be met include: if respondents from different groups interpret the scale items differently or if certain groups have a higher propensity to extreme responses (Karcher and Sass, 2010). Structural invariance indicates that a one-unit change in the item response results in the same change on the underlying factor for both groups. This meets the condition for "strong" invariance (Tucker et al., 2006). Structural invariance may not be met if certain groups have a different reference point when making statements about themselves, there are differences in social norms, and/or certain groups are prone to respond strongly to an item despite having comparable factor values (Chen, 2008; Karcher and Sass, 2010). Structural invariance implies both the meaning of constructs and levels of the underlying items are the same between groups; thus allowing for group comparisons (Van de Schoot et al., 2012).

This research sought to construct multi-item scale(s) measuring adolescents' social environment in the neighbourhoods in which they live. Both individual and neighbourhood measures were derived from adolescent survey data. Psychometric methods were used to validate and measure reliability of individual level measures while ecometric methods were used to measure reliability at the neighbourhood level (Raudenbush and Sampson, 1999). It is important to have both valid and reliable measurements prior to conducting statistical models using these constructs. Accordingly, the objectives of this research were to: a) establish valid and reliable measures of adolescent's neighbourhood conditions, b) assess the psychometric and ecometric properties of these measures, c) test for invariance between urban/rural classifications, and d) generate neighbourhood level scores to be used in further analysis.

7.2 Analysis

7.2.1 Exploratory factor analysis

As a first step exploratory factor analysis was conducted examining the structure of latent variables derived from the items in table 6.1 from Chapter 6. The number of respondents with complete data on all questions of interest was 3,396 out of 3,591. The number of factors were decided on based on the scree plot, retaining all factors with an eigenvalue of greater than 1.0 (Nichol et al., 2010). As suggested by Costello and Osborne (2005), an oblique rotation was utilized and direct oblimin extraction was conducted by principal axis factoring. Items were retained if they had a factor loading $> .40$ and did not cross-load on another factor (factor loading $> .32$, which equates to approximately 10 percent overlapping variance with other items in that factor) (Costello and Osborne, 2005; Fields, 2005). Psychometric properties of each scale were assessed using Cronbach's alpha coefficient (Cronbach, 1951).

7.2.2 Confirmatory factor analysis and invariance testing

Secondly, a confirmatory factor analysis (CFA) was conducted to determine whether the proposed latent variables exhibit equivalence across urban and rural settings using measurement invariance testing methods. This analysis was limited to a subset of the total sample that comprised those individuals with both valid residential postcode data, allowing for classification of residential urban or rural conditions (see Chapter 6, section 6.2.3), and complete data on all variables on the neighbourhood questions (n=2,590). Compared to those who reported their postcode, those excluded due to missing postcode data had a higher proportion of males (53 percent versus 47 percent; Chi-Square =10.5; $p< .01$) but were not significantly different in terms of family affluence distribution.

As noted by Byrne (2010), testing for invariance requires a series of hierarchical steps (table 7.1). First, a configural model was run (a model where no constraints are

placed between groups but the data for all groups are analysed simultaneously). This model acted as the baseline. Secondly, a metric model was established where factor loadings were constrained to be equal among groups. This assessed metric invariance. Third, a structural model was conducted where the factor loadings and intercepts were constrained to be equal. This model was compared to the metric model to assess for "strong" invariance. Because there is debate in the literature regarding how best to test for invariance each model was compared to the subsequent model using four tests: 1) a chi-square (X2) difference test where a non-significant value (p> .05) indicates invariance (Byrne, 2010), 2) the ratio of the change in X2 to the change in degrees of freedom between two models ($\Delta X2/\Delta df$) where a value < 5 indicates invariance (Rosay et al., 2000; Choi et al., 2006), 3) the difference in root mean square error of approximation (RMSEA), and 4) comparative fit index (CFI) values, where a difference of < 0.015 (RMSEA) and $< .01$ (CFI) indicates invariance (Cheung and Rensvold, 2002; Chen, 2007; Byrne, 2010).

Table 7.1: Description of measurement invariance

Invariance type	**Description**
Configural	Different groups associate the same subset of items with the same constructs. To test data are analysed simultaneously and no constraints are placed between groups. This model is used as the baseline model.
Metric (also called weak invariance)	Respondents across groups attribute the same meaning (factor loadings) to the latent construct(s). To test factor loadings are constrained to be equal across groups. This model is compared to the configural model.
Structural (also called scalar or strong invariance)	The meanings (factor loadings) and the levels of the items (intercepts) are equal across groups. To test factor loadings and intercepts are constrained to be equal. This model is compared to the metric model. If this is met, groups can be compared on scores of the latent construct.

7.2.3 Ecometrics

Ecometric approaches were used to derive neighbourhood level scores and to test the reliability of the neighbourhood measure using linear three-level models (Raudenbush and Sampson, 1999; Fone et al., 2006; Prins et al., 2012; Friche et al., 2013; Fagan et al., 2015). Because in this method question response was the dependent variable, with level one a categorical variable of the question/item, level two the individual, and level three the neighbourhood, the reliability of the neighbourhood level measure could be calculated as a function of the neighbourhood variation and the neighbourhood sample size. Reliability has a score close to 1 when the neighbourhood means vary substantially across neighbourhoods (holding sample size constant) or the sample size per group is large (Mujahid et al., 2007). Although there is no agreed cut-off for reliability at the neighbourhood level, generally scores above 0.60 are considered good or acceptable (Hox et al., 2010; Ruijsbroek et al., 2016). Ecometrics mitigates issues associated with using scale means to aggregate to the neighbourhood level because it takes individual differences into account by including these as level two covariates. Measures therefore reflect differences by geographic area rather than respondents' individual characteristics hence controlling for possible measurement bias (Hox et al., 2010). The residuals are used as the neighbourhood variable because they represent what cannot be attributed to individual response patterns with positive values reflecting higher than average levels (Prins et al., 2012). It is important to bear in mind that group level coefficients represent a weighted average estimate of each grouping towards the average of the dataset based on group sample size and distance between the group level estimate, termed 'shrinkage'. Thus the overall estimate potentially biases the estimates towards the overall estimate (Hox et al., 2010). Although some research questions the value of the added complexity of ecometrics over simple mean aggregation, as the results are very similar (Mackenbach et al., 2016), ecometrics allows for reliability to be calculated, which is an important aspect of scale development. Reliability is calculated based on Hox (Hox et al., 2010):

$$\text{Reliability} = \frac{\sigma_N}{\sigma_N + \left(\frac{\sigma_i}{\hat{n}}\right) + \left(\frac{\sigma_j}{k\hat{n}}\right)} \tag{7.1}$$

where σ_N is the neighbourhood variance, σ_i is the individual variance, σ_j is the item variance, $\hat{n}$ is the average number of people per area, and k is the number of items.

In this study, individual item responses were imputed prior to ecometric analysis using the person average of available items in each scale, if less than half were missing (Katz, 2006). Imputation methods on item responses have been used in similar models (Finch, 2008). An alternative would have been to accommodate the missing data in the model (Hox et al., 2010). However, the best approach to missing items in these types of models is still under study (Finch, 2008), so this straightforward approach was used.

Individuals residing in an area (IDZ) with less than five respondents were excluded (see Chapter 6, section 6.2.2.9). This cut-off is similar to other studies of adolescent neighbourhoods (Prins et al., 2012). A sensitivity analysis was also conducted using a cut-off of four to allow for additional IDZs to be included in the analyses. Those who were missing data on any of the scale items after imputation (four individuals on each scale had imputation procedures) were excluded, leaving 1,491 respondents on the neighbourhood disorder scale and 1,509 on the social cohesion scale from approximately 190 IDZs for both scales. Those included did not have a significantly higher proportion of males or females than those not included from the total sample, but they were significantly more likely to be in the high family affluence tertile (38 percent versus 33 percent). Respondents' sex was adjusted for in the model as it may influence individuals' experiences of their neighbourhood (Prins et al., 2012).

7.3 Results

7.3.1 Exploratory factor analysis

The scree plot indicated a two-factor solution explaining 42.7 percent of the variance (34.3 percent in the 1st factor and 8.4 percent in the 2nd factor) (see figure 7.1). Using the two-factor solution, the factors were 1) social cohesion (Items 3, 4, 5, 7), and 2) neighbourhood disorder (Items 9, 10, 11). Perceived good places, feeling safe, and people would try to take advantage of you, did not load $> .4$ on either factor while perceiving the local area as good cross-loaded between the two factors (table 7.1). A three-factor solution was also obtained and yielded similar results with the exception that having good places to spend free time, loaded on its own factor. Given current debate on best methods to determine the number of factors to maintain, a parallel analysis and Velicer's minimum average partial criteria were conducted using an R-add on designed for SPSS (Basto and Pereira, 2012). These represent two alternative methods for determining the number of factors to extract based on a comparison with a randomly generated correlation matrix and examination of a series of correlation matrices, respectively (Basto and Pereira, 2012). The Velicer's minimum average partial criteria indicated two factors be maintained and the parallel analysis indicated four factors. The four-factor solution produced two non-trivial factors (single item factors) that mirrored the two-factor solution presented earlier. Therefore, a two-factor solution was implemented in the CFA. Cronbach's alpha for social cohesion was .787 and the alpha for neighbourhood disorder was .765.

7.3.2 Confirmatory factor analysis

From the CFA results, a two-factor solution was specified using AMOS software employing maximum likelihood (ML) estimation. Results of the configural model indicated good model fit (RMSEA=.027, GFI)=.975, CFI=.970, TLI)=.951). However, X2

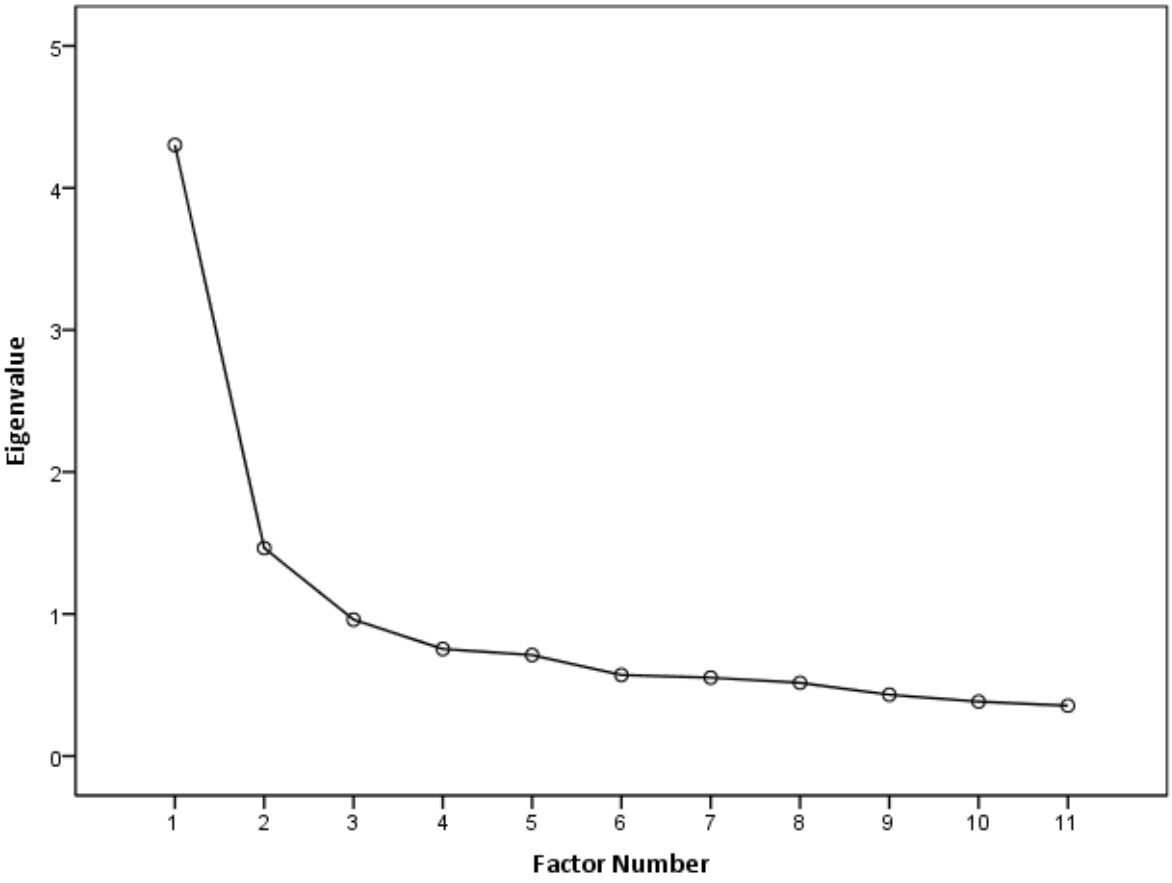

Figure 7.1: Scree plot showing the number of factors in exploratory factor analysis

difference tests indicated non-invariance (difference in X2 was significant between the configural model and metric model as well as between the metric model and the structural model) while ΔX2/ Δdf, RMSEA, and CFI difference tests indicated invariance between model comparisons (table 7.3). Results of the modification indices were examined and Item 7 ("I could ask for help or favour from a neighbour") was removed due to high error covariance with other items. Removing this item from the social cohesion scale yielded a Cronbach's alpha of .760.

After removing Item 7, the six-item configural model indicated improved model fit (RMSEA=.022, GFI=.986, CFI=.986, TLI=.973), meeting the requirement for config-

Table 7.2: HBSC questions regarding local area social environment and factors loadings of HBSC items regarding the neighbourhood social environment ($n = 3396$).

Number	Item	Factor 1	Factor 2
1	Feel safe in local area R	.319	-.397
2	Local area is a good place to live R	.423	-.352
3	In the area where you live you can trust people around here R	**.691**	–
4	People say "hello" and talk to each other in the streets in the area where you live R	**.665**	–
5	It is safe for younger children to play outside in the area where you live R	**.596**	–
6	There are good places to spend free time in the area where you live R	.397	–
7	I could ask for help or favour from a neighbour in the area where you live R	**.675**	–
8	Most people around here would try to take advantage of you if they got a chance in the area where you live R	–	.385
9	In the area where you live are there are groups of young people who cause trouble R	–	**.809**
10	In the area where you live are there are litter, broken glass or rubbish lying around R	–	**.769**
11	In the area where you live are there are run-down houses or buildings R	–	**.619**
Eigenvalue		4.30	1.47

R = recoded variable
Factor loadings below .30 are not reported
Bold indicates the item loaded above .40 on a factor and did not cross-load

ural invariance. Additionally criteria for metric invariance were met by all four tests; structural invariance was met using the ΔX2/ Δdf, RMSEA, and CFI tests (table 7.3).

Ad hoc tests for multivariate normality were conducted for each urban/rurality type. Overall, the Mardia's coefficient of multivariate kurtosis suggests non-normality in the sample (range: 4.65-15.35 where a value$>$ 1.96 indicates non-normality) (Byrne,

Table 7.3: Model fit statistics for invariance testing for seven- and six-item models ($n = 2590$)

Model	χ^2	$\Delta\chi^2$	df	Δdf	$\frac{(\Delta\chi^2)}{(\Delta df)}$	RMSEA	ΔRMSEA	CFI	ΔCFI
Seven-item model									
Configural	228.63		78			.027		.970	
Metric	277.28	48.65*	103	25	**1.95**	.026	**-.003**	.965	**-.005**
Structural	308.76	31.48*	118	15	**2.10**	.025	**-.001**	.962	**-.003**
Six-item model									
Configural	106.76		48			.022		.986	
Metric	130.79	**24.03**	68	20	**1.20**	.019	**-.003**	.985	**-.001**
Structural	166.49	35.70*	83	15	**2.38**	.020	**.001**	.980	**-.005**

*significant at 0.05
Bolded values indicate invariance

2010). Given this, additional models were conducted with asymptotically distribution-free (ADF) estimation (also known as weighted least squares). ADF does not require normality but studies have shown it is only powerful for relatively simple models with a moderate to large sample size (some suggest n> 1000) (Flora and Curran, 2004; Finney and DiStefano, 2006; Jones and Waller, 2015). Results were similar to ML estimation but the difference in CFI between the metric model and structural model was -.012. Many studies of invariance testing procedures have been undertaken using ML estimation. Also, there are no standards on appropriate tests and cut-offs for alternative estimation methods. However, there is some indication that ΔRMSEA performs well with ordinal data (Koziol, 2010; Ranøyen et al., 2015).

There were significant differences between urban and rural areas on both perceived neighbourhood social cohesion and perceived neighbourhood disorder found through analysis of variance (ANOVA) tests (table 7.4). An urban/rural gradient was observed with perceived social cohesion increasing as the population size of a community decreased and distance to a larger centre increased (F=34.08, p< .001). Adolescents in remote and accessible rural areas perceived greater social cohesion than their urban counterparts. Those in rural areas also perceived lower neighbourhood disorder

than those in urban or small-town communities; whereas individuals living in accessible small-towns had the highest levels of perceived disorder (F=15.34,p< .001).

Table 7.4: Mean individual perceived neighbourhood social cohesion (range 3-15) and perceived neighbourhood disorder (range 3-9), n=2590 (95% confidence intervals).

	Social cohesion		Neighbourhood disorder	
Large urban areas	11.05	(10.83, 11.26)	5.03	(4.90, 5.15)
Other urban areas	11.34	(11.13, 11.55)	4.98	(4.85, 5.11)
Accessible small town	11.75	(11.47, 12.04)	5.39	(5.22, 5.56)
Remote small town	11.99	(11.69, 12.29)	4.93	(4.74, 5.12)
Accessible rural	12.53	(12.28, 12.78)	4.53	(4.38, 4.67)
Remote rural	12.75	(12.54, 12.97)	4.60	(4.47, 4.72)

7.3.3 Ecometrics

The ecometric properties of both neighbourhood level social cohesion and neighbourhood level disorder are shown below. Both scales showed moderate reliability, but within the range considered acceptable in several other studies, at .577 and .563 respectively (Mujahid et al., 2007; Prins et al., 2012).

$$\text{Reliability}_{sc} = 0.577 = \frac{0.110}{0.110 + \left(\frac{0.438}{7.778}\right) + \left(\frac{0.569}{3\times 7.778}\right)} \tag{7.2}$$

$$\text{Reliability}_{nd} = 0.563 = \frac{0.037}{0.037 + \left(\frac{0.159}{7.806}\right) + \left(\frac{0.192}{3\times 7.806}\right)} \tag{7.3}$$

Sensitivity analysis showed that when the cut-off was changed to four individuals per IDZ rather than five per IDZ, the reliability for neighbourhood social cohesion and neighbourhood disorder dropped to .524 and .543, respectively. However, the number of neighbourhoods increased from approximately 190 to 250. Additionally, the number of individual survey respondents increased by approximately 250. Given the substantial increase in neighbourhoods and that the reduction in reliability was not great (reliability was still $>$ .50) validity analysis using the cut-off of four was conducted (IDZs

n= approximately 250). When using a minimum threshold of 4, those included did not have a significantly higher proportion of males or females than those not included from the total sample, but they were significantly more likely to be in the high family affluence tertile (38 percent versus 33 percent). Moreover, due to the small number of response categories in the neighbourhood disorder items, the original model was re-run as an ordinal outcome three-level model. This also made little difference to reliability (reliability=.589 versus 0.563).

Convergent validity was tested by examining the correlations between neighbourhood level constructs and administrative measures available for the IDZs from the The Scottish Government (2016*a*). The percent of people living within 500 metres of a derelict site in 2010 was examined, expecting to find a positive correlation with neighbourhood level disorder. Also the estimated percent of working-aged households that were materially deprived in 2008/2009 was hypothesised to have a negative correlation with neighbourhood social cohesion, as a similar relationship has been found in past studies using adult survey measures (Drukker et al., 2003). As was expected, neighbourhood social cohesion and neighbourhood disorder were significantly and negatively correlated (R=-.499, p< .001). Also, a positive correlation was found between proportion of people living near derelict sites and neighbourhood disorder (R=.365, p < .001) and a negative association was found with neighbourhood social cohesion (R=-.320, p < .001). In terms of material deprivation, a negative correlation was present with neighbourhood social cohesion (R=-.396, p < .001) and a positive correlation was found with neighbourhood disorder (R=.410, p < .001).

7.4 Discussion

To my knowledge, this is the first attempt to construct neighbourhood scales for adolescents at both the individual and neighbourhood level that considers potential invariance across urban/rurality. Measures across two dimensions of adolescents' neighbourhood

social environment were constructed with both yielding good reliability at the individual level and moderate reliability at the neighbourhood level. However, it is important to note that the response system varied for the neighbourhood questions and that EFA results largely corresponded with this. Nevertheless, the two measures perform well in CFA.

The findings from this analysis are consistent with past research on the psychometric and ecometric properties of adolescent neighbourhood scales. Studies of rural and urban US adolescents found similar individual level reliabilities. For example, a measure of neighbourhood attachment that used some similar indicators to this study reported a Cronbach's alpha of .72 (Van Gundy, Stracuzzi et al. 2011) and a measure of neighbourhood deterioration using comparable measures reported a Cronbach's alpha of .75 (Vowell, 2007). Additionally, findings are consistent with a study of neighbourhood level social capital in Dutch adolescents which found what the authors deem acceptable levels of neighbourhood social capital at .57 (Prins et al., 2012).

Adjustments to the originally specified model improved model fit and measures of invariance. The results of invariance testing indicate "weak" (metric) invariance between different urban/rural locations for the six-item model was certainly met. There is also evidence of "strong" (structural) invariance, however, these results are more sensitive to estimation procedure and invariance test used and therefore should be interpreted with caution. Issues with X2 difference test have been widely noted as it is sensitive to sample size (Cheung and Rensvold, 2002; Choi et al., 2006; Byrne, 2010). Therefore, the other approaches used to test for invariance may be more appropriate; so this study shows, with reasonably confidence, that strong invariance is met.

Regarding the ecometric analysis, it was possible to construct measures that reflect collective attributes that showed moderate reliability. Trade-offs between neighbourhood sample size and reliability had to be considered, as reliability decreases as a function of within neighbourhood sample size. There are no established cut-offs for

reliability in ecometric analysis and so the researcher must consider the trade-off between sample size and reliability. Estimates of convergent validity were as expected, indicating that valid measures of the neighbourhood level social environment can be constructed using survey data from adolescents. This is similar to findings based on surveys of adults (Friche et al., 2013).

A potential limitation of the current study is that an administrative boundary definition was used as a proxy of neighbourhoods. The IDZs were constructed with consultation from those with local knowledge (by consultation with Community Planning Partnerships who coordinated the views of local people and regional officials); however, these partnerships are administratively based and therefore do not necessarily include adolescents. Additionally, the questions in the HBSC survey asked adolescents about the "local area" in which they lived but did not specify how local area should be defined and it was not possible to determine how the administrative boundaries relate to the adolescents' perceptions of their local area boundaries. This may contribute to within-neighbourhood variability (Friche et al., 2013). Despite these limitations, IDZs reflect a neighbourhood definition for which other data from government sources can be linked.

Another consideration when interpreting the results is the potential for bias due to the presence of missing cases; particularly the proportion who were missing due to non-reporting of postcode data and missing data due to a low number of respondents within neighbourhoods. This is a common issue in studies that collect neighbourhood data but are not able to target at the neighbourhood level, such as in school-based surveys (i.e., Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016).

Although the measures established in this research are suitable for individuals experiencing urban and rural conditions in Scotland they may not be invariant cross-culturally. Further studies are needed to better understand how perceptions of neighbourhoods may vary between countries. This represents an important avenue for future research of neighbourhood characteristics. Additionally, the compromise between reliability, sam-

ple size, and having an appropriate number of respondents per neighbourhood is an important area for future research.

In conclusion, constructing valid and reliable measures at different levels represents a crucial first step in understanding the ways in which adolescents experience their local areas. The two scales validated in this study can be used to investigate the effect of neighbourhood environmental characteristics, specifically social cohesion and neighbourhood disorder, on a range of outcomes and from a population health perspective. Neighbourhood social cohesion was defined by three items regarding trust of people in the neighbourhood, neighbours talking to each other, and safety for younger children to play outside. Neighbourhood disorder was also measured with three items concerning groups of young people causing trouble, litter, and run-down buildings. By accessing adolescent's own perceptions of the area in which they live, these instruments represent a more useful and appropriate means to measure the impact of neighbourhood on adolescent outcomes than many existing measures which are mainly based on adult perceptions or structural indicators.

Chapter 8

The neighbourhood social environment and adolescent alcohol use in urban and rural Scotland

This chapter is partly based on work under revision for publication in the International Journal of Public Health

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8.1 Introduction

As discussed in Chapter 3, evidence suggests adolescent alcohol use varies across neighbourhoods (Fagan et al., 2015; Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016). However, which specific neighbourhood characteristics underlie this variation is not fully understood (Fagan et al., 2015). Many features of the neighbourhood are thought to be associated with adolescent alcohol use (Fagan et al., 2015). Studies examining neighbourhood socioeconomic factors have found mixed results (Bryden et al., 2013; Jackson et al., 2014), thus implying that more research is required to examine neighbourhood social factors. Neighbourhood social conditions, such as cohesion and collective efficacy, have drawn more recent attention, and are often posited to underlie the relationship between neighbourhood economic conditions and alcohol use (Fagan et al., 2013; Jackson et al., 2014). Theories of the social environment and substance use suggest that the positive bonds in society deter adolescents from substance use (Wray-Lake et al. 2012). While, neighbourhoods with greater disorder may encourage alcohol use as a way of coping with environmental stress (Hill and Angel, 2005). However, reviews of neighbourhood social factors and drinking behaviour among adolescents indicate varied findings (Bryden et al., 2013; Jackson et al., 2014). This may, in part, reflect equivocal measurements of the social environment (Martin, Inchley, Humphris and Currie, 2017) and/or different drinking outcomes included in these studies.

Research examining neighbourhood characteristics and adolescent drinking typically focuses on urban environments (Bryden et al., 2013). However, adolescents' urban/rural status has been found to be associated with their alcohol use and has been hypothesised to contribute to geographic variation in drinking behaviours (Slutske et al., 2016). Contemporary research has shown that adolescents residing in rural areas tend to drink alcohol at higher rates than those in urban areas (Dixon and Chartier, 2016; Donath et al., 2011). The mechanisms behind this are not well understood but may be due

to physical and/or cultural differences that exist between these communities (Donath et al., 2012).

As previously noted in Chapter 3, there has also been interest in the associations between commercial alcohol availability and adolescent alcohol use. Bryden et al. (2012) report that the evidence is inconclusive regarding these relationships. Increased availability may make alcohol purchasing easier through greater physical access and reduced prices, due to market competition (Shortt et al., 2018; Treno et al., 2013). However, as it is often illegal to sell alcohol to someone under a certain age, 18 in Scotland, the presence of outlets does not necessarily mean alcohol is easily available. More likely, a higher density of alcohol outlets may influence adolescent alcohol use via neighbourhood social norms and the normalisation of alcohol consumption (Kuntsche et al., 2008; Shortt et al., 2018). It is important to consider alcohol availability as an important covariate in order to avoid biased conclusions about the influence of the social characteristics of the neighbourhood on alcohol use (Mohnen et al., 2011). This is particularly relevant given that more alcohol outlets tend to be present in areas of both higher deprivation and lower social capital (Shortt et al., 2015; Theall, Scribner, Cohen, Bluthenthal, Schonlau and Farley, 2009).

Results from neighbourhood studies that only assess neighbourhood variation may be misleading if variation from other contexts, such as school, are ignored (De Clercq et al., 2014; Dunn et al., 2015). Studies that examined adolescent smoking, using cross-classified multilevel models to account for the influence of non-nested contexts (where individuals are nested in schools and neighbourhoods, but schools are not necessarily nested within neighbourhoods or vice versa) found that neighbourhood effects are overestimated when ignoring school-level variation (De Clercq et al., 2014; Dunn et al., 2015).

Previous studies have examined whether the neighbourhood social environment interacts with other neighbourhood characteristics such as alcohol availability, and neigh-

bourhood deprivation in terms of adolescent alcohol use (Ennett et al., 2008; Maimon and Browning, 2012; Wen, 2017) and whether a cumulative effect is present. For example, (Maimon and Browning, 2012) found that those residing in areas with higher alcohol outlet density and lower collective efficacy had higher predicted probability of alcohol use. Additionally, given the dearth of studies in non-urban regions, further investigation into whether the association between the neighbourhood social environment and adolescent alcohol use varies by urban/rurality is warranted. Additionally, sex is examined as a potential modifier as it has previously been acknowledged as such in studies on adolescent drinking in Glasgow (Young et al., 2012).

No study to-date has examined the role of the neighbourhood social environment on adolescent drinking in Scotland. Additionally, past studies focus on urban areas, overlooking potential urban/rural differences.

Accordingly, the research presented in this Chapter aims to address the following questions:

1. To what extent does adolescent alcohol use vary by neighbourhood?

2. Are there associations between neighbourhood characteristics and adolescent alcohol use?

3. Are there interactions between the neighbourhood social environment and alcohol outlet density, neighbourhood socioeconomics, urban/rurality, and sex?

8.2 Method

8.2.1 Participants

The 2009/2010 Scottish HBSC S4 survey data was used in this analysis. The data was described in Chapter 6, section 6.2.2.

Pupils reported their residential postcode (more details available in Chapter 6, section 6.2.2).

To increase the reliability of neighbourhood-level measures derived from aggregated individual level responses (neighbourhood social cohesion and neighbourhood disorder), the sample was limited to 1,561 students who reported their postcode and resided in an IDZ with 5 or more students (Martin, Inchley, Humphris and Currie, 2017; Prins et al., 2014). Those included in the study were significantly ($p < 0.05$) more likely to be in the high family affluence tertile, and to report their ethnicity as white, than those excluded; but were no more likely ($p > 0.05$) to be male, have ever drank, drink weekly, or have been drunk twice or more. An additional three students were removed from analysis based on inconsistent responses on the alcohol use questions (figure 8.1).

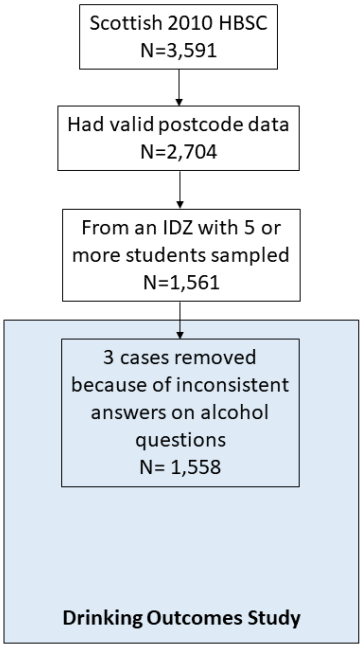

Figure 8.1: Participant inclusion flowchart, drinking outcomes

8.2.2 Measures

8.2.2.1 Drinking behaviours

Three drinking behaviours were considered in these analyses. 1) Ever drank was classified as those who reported an age at which they had first drunk alcohol ('more than a small amount') as opposed to 'never.' 2) Weekly drinking was calculated by the following question: 'at present how often do you drink anything alcoholic, such as beer, wine or spirits? Try to include even those times when you only drank a small amount.' Responses included frequency of consumption (every day, every week, every month, hardly ever, and never). Those who reported drinking any beverages daily or weekly were classified as weekly drinkers. 3) Drunkenness was assessed with the following question: "Have you ever had so much alcohol that you were really drunk?" Responses were: never, once, 2–3 times, 4–10 times, more than 10 times. This was dichotomised into less than twice or twice or more.

8.2.2.2 Demographics and family characteristics

Sex, age, ethnicity, and family structure were included in the analyses. Additionally, as recent studies have found family affluence has been found to be associated with adolescent drinking outcomes, with those in more affluent families drinking more (Obradors-Rial et al., 2018), this was also included.

8.2.2.3 Neighbourhood characteristics

Data on alcohol outlets were classified as on-trade (i.e., bars or restaurants) and off-trade (i.e., shops) (Shortt et al., 2018). As a first step, the models were run with an 800m radius as this approximately equates to a 10-minute walk (Shortt et al., 2016). Sensitivity analysis was also conducted using the 400m and 1000m radius.

Urban/rurality and neighbourhood socioeconomic condition were included. Neigh-

bourhood socioeconomic characteristics was determined by the income domain of the SIMD 2010. Using the income domain as the most appropriate indicator of neighbourhood socio-economic circumstances follows the precedent of past studies (Levin et al., 2014; Shortt et al., 2015). The two most deprived categories were combined, as few of the sample (8 percent) resided in the most-deprived quintile.

Neighbourhood social cohesion was measured using three questions from the HBSC survey (as outlined in Chapter 7): in the area where you live 1) you can trust people around here, 2) people say "hello" and talk to each other in the streets, and 3) it is safe for younger children to play outside. Responses ranged from "agree a lot" to "disagree a lot", on a five-point scale. The Cronbach's alpha at the individual-level (perceived social cohesion) was 0.745. Neighbourhood disorder was measured using the same procedure. Three questions were used in this measure: in the area where you live are there 1) groups of young people who cause trouble? 2) litter, broken glass or rubbish lying around? and 3) run-down houses or buildings? Responses ranged from "none" to "lots", on a three-point scale. The Cronbach's alpha for these at the individual level (perceived disorder) was 0.754. Both measures have been previously validated (items were found to highly correlate) using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), and show measurement invariance between urban/rural classifications (Martin, Inchley, Humphris and Currie, 2017), see Chapter 7.

Neighbourhood level aggregation occurred using a three-level item response model accounting for item severity and the respondent's sex (Martin, Inchley, Humphris and Currie, 2017) (see Chapter 7). The reliability at the neighbourhood level for neighbourhood level social cohesion and neighbourhood level disorder were 0.577 and 0.563, respectively.

8.2.3 Statistical analysis

Analysis was conducted to examine whether the three adolescent drinking outcomes did indeed vary by neighbourhood (IDZs) (Research Question 1). This was done by fitting an empty 2-level random intercept model with adolescents as level-1 and neighbourhoods at level-2, with no covariates (Robson and Pevalin 2015). These models assume a 2-level structure where adolescents are only nested in neighbourhoods (ignoring schools). Second, a 2-level model was run with schools at level-2 (ignoring neighbourhoods) (Dunn et al., 2015). Third, in a cross-classified model, individual adolescents were grouped simultaneously into two non-nested contexts (neighbourhood and school). A variance partition coefficient (VPC) (the amount of variance accounted for at the neighbourhood level) was calculated to estimate the proportion of variance in drinking outcomes that are attributed to neighbourhoods and schools.

A second series of models were conducted to address Research Question 2. Only individuals with complete data on all covariates were included in multivariable models. Model 1 represents a two-level neighbourhood model which included individual socio-demographic factors. Model 2 also included alcohol outlet density and urban/rurality. Model 3 added neighbourhood deprivation. Models 4 and 5 added neighbourhood level social cohesion and neighbourhood disorder, respectively. Model 6 included neighbourhood social cohesion and neighbourhood disorder together. Model 7 added individual perceptions. Model 8 included a cross-classified specification for school-level variation to ensure associations noted were indeed at the neighbourhood-level. The sample was reduced to drinkers when examining weekly drinking and drunkenness.

Variance inflation factor values were below 3 (full sample: mean=1.73, min=1.01, max=2.60; sample of those who drank: mean=1.74, min=1.01, max=2.75) for all independent variables indicating that multicollinearity was not a concern (Obrien, 2007). All models were conducted using runmlwin (Leckie and Charlton, 2013) via Stata and MLWin with Bayesian estimation procedures as implemented by Markov Chain Monte

Carlo (MCMC) methods. Because no previous knowledge was assumed, the MLWin default diffuse prior distributions were used for all estimates. Initial values were derived from an iterative generalized least squares algorithm and Metropolis Hastings sampling was used (Browne, 2017; Leckie and Charlton, 2013). Odds ratios are reported with 95 percent credible intervals and p values. Bayesian DIC was used to test for improvement of model fit, with lower values indicting better fit (see Chapter 6, section 6.3.1.3). This method was best suited to these analyses as it is appropriate for low numbers of respondents in higher levels of a multilevel model, and because maximum likelihood methods are found to be inefficient for cross-classified models (De Clercq et al., 2014; Leckie and Charlton, 2013).

Random slopes interactions and random intercept interactions were added to Model 7 to address Research Question 3 (Browne, 2017). Each interaction was specified in a separate model. Random intercepts are interpreted in the results and the random slope model acts as a sensitivity analysis. In the interaction analysis, the neighbourhood social environment in the interaction term was standardised, as suggested by Aguinis et al. (2013). This made the results more straightforward to interpret, although the p value of the estimate was unchanged. Additionally, without standardisation each estimate had large standard errors. This may be due to increased multicollinearity due to the introduction of the interaction term (Robson and Pevalin, 2015).

8.3 Results

8.3.1 Participant characteristics

Table 8.1 outlines the characteristics of the sample. The majority of adolescents had ever drank (83 percent); while almost half of the respondents (45 percent) had been drunk twice or more. Twenty-seven percent of the respondents were weekly drinkers.

8.3.2 Empty models

For ever drank, weekly drinking, and drunkenness, neighbourhood accounts for 9.7 percent, 5.7 percent, and 3.6 percent, of the variation, respectively, when ignoring school level variation. This was reduced to 7.6 percent, 5.0 percent, and 1.0 percent, respectively, when accounting for school level variation. For ever drank and weekly drinking, the DIC was lowest in the cross-classified model compared to the two-level models, suggesting best fit when including both levels (table 8.2). For drunkenness, the DIC was only slightly lower in the cross-classified model, compared to the school-only model.

8.3.3 Multivariable models

Urban/rurality showed a clear gradient in alcohol use (tables 8.3 and 8.4), those in remote and rural regions had higher odds of having ever drank than those in large cities; while those in smaller urban areas were not significantly different in terms of ever drinking ($p > 0.05$). A significant association was present for neighbourhood social cohesion on having ever drank alcohol (Odds Ratio=0.33, p=0.017), in fully adjusted models. Including this measure also improved model fit compared to the null model (DIC = 1301.69 versus 1304.15). No significant associations were found for AODs or neighbourhood level disorder with having ever drank ($p > 0.05$); however individual perceived disorder was associated with having ever drank, (Odds Ratio=1.24, p=0.001).

Table 8.1: Descriptive statistics of the study sample ($n = 1558$).

Characteristics	Valid n	Mean(SD)/n(%)	Min	Max
Demographics and family characteristics				
Age	1554	15.55(0.33)	13.25	16.67
Male	1558	1558		
White	1558	1515(97%)		
Family Affluence	1558			
Low		496(32%)		
Medium		479(31%)		
High		583(37%)		
Family Structure	1530			
Both parents		1080(71%)		
Single parent		274(18%)		
Step family/other		176(11%)		
Individual neighbourhood perceptions				
Perceived neighbourhood disorder [a]	1516	4.92(1.53)	3	9
Perceived social cohesion [a]	1522	11.98(2.59)	3	15
Residential characteristics				
Neighbourhood deprivation	1558			
1 (Most deprived)		343(22%)		
2		358(23%)		
3		461(30%)		
4 (Least deprived)		396(25%)		
Urban/rurality	1554			
Large urban		263(17%)		
Other urban		267(17%)		
Accessible small town		193(12%)		
Accessible rural		241(15%)		
Remote small town		198(13%)		
Remote rural		392(25%)		
Off trade alcohol outlets (800m)	1557	1.59(1.87)	0	14.25
On trade alcohol outlets (800m)	1557	2.91(4.17)	0	38.31
Neighbourhood-level disorder [b]	1488	-0.01(0.14)	-0.27	0.37
Neighbourhood-level social cohesion [c]	1506	0.04(0.25)	-0.61	0.64
Alcohol use				
Have ever drank	1550	1281(83%)		
Drink weekly	1553	414(27%)		
Drunk twice or more	1545	689(45%)		

SD=Standard deviation.
a If less than half the items were missing mean person imputation was used. This occurred in $< 1\%$ of cases.
b At the neighbourhood level mean = 0 for 191 neighbourhoods.
c At the neighbourhood level mean = 0 for 194 neighbourhoods.

Table 8.2: Empty models examining drinking behaviours across neighbourhoods and schools (95% credible intervals)

	Neighbourhood only	**School only**	**Cross-classified**
Have ever drank (n=1550)			
Neighbourhood level variance	0.353 (0.083,0.677)*		0.281 (0.011,0.631)
School level variance		0.303 (0.072,0.608)*	0.147 (0.002,0.475)
Neighbourhood % of variance accounted for	9.7		7.6
School % of variance accounted for		8.4	3.9
DIC	1411.31	1414.74	1409.31
Weekly drinking (n=1553)			
Neighbourhood level variance	0.199 (.007,0.445)		0.177 (0.005,0.423)
School level variance		0.114 (0.001,0.318)	0.059(0.001,0.248)
Neighbourhood % of variance accounted for	5.7		5
School % of variance accounted for		3.3	1.7
DIC	1791.45	1797.58	1790.5
Lifetime drunkenness (n=1545)			
Neighbourhood level variance	0.123 (0.002,0.310)		0.034 (0.001,0.173)
School level variance		0.155 (0.002,0.346)	0.146 (0.011,0.329)
Neighbourhood % of variance accounted for	3.6		1
School % of variance accounted for		4.7	4.2
DIC	2119.55	2110.63	2110.48

* $p < 0.05$; Significance determined by z-score probability in multilevel models;
Burn-in 5,000; chain 200,000;
DIC= Deviance Information Criterion;
DIC is used to examine for model fit improvement in cross-classified models by comparing to non-cross-classified models.

Table 8.3: Having ever drank regressed on neighbourhood and individual measures (95% credible intervals) (n=1457; Intermediate Data Zones n=190; Schools n=152), (Models 1-4)

Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Sex (male)	1.00 (0.74.1.29)	1.01 (0.74.1.33)	1.01 (0.74.1.34)	1.00 (0.74.1.33)
Age	1.98 (1.26,2.80)***	1.87 (1.13,3.12)**	1.76 (1.07,2.87)**	2.12 (1.19,2.96)**
Family Structure (Ref: both parents)				
single parent	1.45 (0.95,2.14)	1.42 (0.96,1.98)	1.38 (0.90,2.07)	1.37 (0.89,2.05)
step-family/other	2.20 (1.24,3.72)**	2.09 (1.18,3.55)*	2.01 (1.14,3.43)*	2.05 (1.15,3.51)*
Family Affluence (Ref: low)				
medium	1.46 (0.98,2.08)	1.42 (0.96,2.04)	1.46 (0.99,2.11)	1.49 (1.00,2.15)
high	1.39 (0.96,1.94)	1.41 (0.97,1.98)	1.48 (1.01,2.08)*	1.51 (1.03,2.15)*
Ethnicity (white)	3.39 (1.51, 6.48)**	2.96 (1.30,5.79)**	2.94 (1.31,5.71)*	3.00 (1.32,5.82)**
On trade licence density		0.97 (0.93,1.02)	0.98 (0.93,1.03)	0.97 (0.93,1.03)
Off trade license density		1.06 (0.93,1.20)	1.04 (0.91,1.17)	1.02 (0.90,1.16)
Urban/rurality (Ref: large cities)				
other urban		1.42 (0.83,2.30)	1.39 (0.80,2.29)	1.46 (0.84,2.40)
accessible small towns		1.83 (0.97,3.19)	1.79 (0.94,3.13)	1.99 (1.04,3.52)*
accessible rural		1.95 (1.06,3.29)*	2.02 (1.08,3.47)*	2.43 (1.27,4.19)**
remote small towns		3.23 (1.61,5.97)**	3.07 (1.50,5.71)**	3.66(1.79,6.84)***
remote rural		2.59 (1.46,4.29)**	2.60 (1.43,4.39)**	3.59(1.88,6.33)***
Neighbourhood deprivation (Ref: 1 most deprived)				
2			1.03 (0.61,1.63)	1.20 (0.70,1.92)
3			0.78 (0.46,1.23)	0.94 (0.55,1.49)
4 least deprived			0.81 (0.47,1.28)	0.99 (0.57,1.61)
Neighbourhood social cohesion				0.34 (0.13,0.71)**
Neighbourhood disorder				
Perceived social cohesion				
Perceived disorder				
Neighbourhood variance	0.36 (0.07,0.72)	0.30 (0.03,0.66)	0.32 (0.01,0.69)	0.29 (0.02,0.65)
School variance				
DIC	1304.15	1302.91	1307.21	1301.69
Residual Moran's I				

Burn-in 5,000; chain 200,000;
DIC=Deviance Information Criterion;
Respondents missing on any predictor or outcome were not included in the models;
$* = p < 0.05$, $** = p < 0.01$, $***p < 0.001$

Table 8.4: Having ever drank regressed on neighbourhood and individual measures (95% credible intervals) (n=1457; Intermediate Data Zones n=190; Schools n=152) (Models 5-8)

Variable	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Sex (male)	1.01 (0.74.1.33)	1.01 (0.74.1.34)	1.02 (0.75,1.35)	1.02 (0.75,1.36)
Age	2.00(1.37,2.78)***	2.04 (1.30,2.92)**	1.83(1.37,2.49)***	1.89 (1.25,2.78)**
Family Structure (Ref: both parents)				
single parent	1.40 (0.90,2.08)	1.37 (0.89,2.04)	1.31 (0.84,1.96)	1.30 (0.84,1.96)
step-family/other	2.04 (1.15,3.48)*	2.05 (1.16,3.49)*	2.00 (1.13,3.40) *	2.00 (1.13,3.42)*
Family Affluence (Ref: low)				
medium	1.48 (0.99,2.14)	1.50 (1.00,2.15)*	1.50 (1.00,2.18)	1.52 (1.01,2.21)*
high	1.49 (1.01,2.12)*	1.51 (1.02,2.15)*	1.51 (1.02,2.16)*	1.53 (1.03,2.19)*
Ethnicity (white)	3.09 (1.37,5.90)**	3.06 (1.31,5.95)**	2.74(1.17,5.43) *	2.78 (1.18,5.52)*
On trade licence density	0.97 (0.93,1.03)	0.97 (0.92,1.03)	0.97(0.93,1.03)	0.97 (0.92,1.03)
Off trade license density	1.04 (0.91,1.18)	1.02 (0.90,1.16)	1.01 (0.88,1.15)	1.02 (0.89,1.16)
Urban/rurality (Ref: large cities)				
other urban	1.40 (0.81,2.30)	1.47 (0.85,2.40)	1.48 (0.84,2.44)	1.45 (0.81,2.42)
accessible small towns	1.71 (0.89,3.05)	2.02 (1.03,3.58)*	2.02 (1.04,3.62)*	2.12 (1.04,3.91)*
accessible rural	2.06 (1.09,3.57)*	2.46 (1.29,4.28) **	2.50 (1.31,4.40) **	2.53 (1.31,4.51)**
remote small towns	3.12 (1.53,5.82)**	3.70(1.80,6.94)***	3.83(1.83,7.21)***	4.07(1.91,7.88)***
remote rural	2.71 (1.48,4.61)**	3.64(1.91,6.37) ***	3.61(1.87,6.43)***	3.60(1.83,6.50)***
Neighbourhood deprivation (Ref: 1 most deprived)				
2	1.09 (0.65,1.75)	1.21 (0.70,1.95)	1.26 (0.73, 2.04)	1.30 (0.75,2.13)
3	0.85 (0.50,1.37)	0.94 (0.54,1.52)	1.01 (0.58, 1.63)	1.02 (0.59,1.66)
4 least deprived	0.88 (0.50,1.44)	1.01 (0.57,1.66)	1.05 (0.59,1.74)	1.09 (0.60,1.81)
Neighbourhood social cohesion		0.33 (0.12,0.75)*	0.33 (0.10,0.80)*	0.33 (0.10,0.77)*
Neighbourhood disorder	2.57 (0.53,7.92)	1.25 (0.22,4.10)	0.45 (0.06, 1.62)	0.45 (0.06,1.61)
Perceived social cohesion			.99 (0.93,1.06)	0.99 (0.92,1.06)
Perceived disorder			1.24(1.10,1.40)***	1.23 (1.09,1.39)**
Neighbourhood variance	0.32 (0.03,0.69)	0.30 (0.03,0.66)	0.31 (0.04,0.68)	0.19 (0.00,0.60)
School variance				0.16 (0.00,0.52)
DIC	1306.65	1302.86	1291.59	1292.85
Residual Moran's I				0.016 (p=0.505)

Burn-in 5,000; chain 200,000;
DIC=Deviance Information Criterion;
Respondents missing on any predictor or outcome were not included in the models;
$* = p < 0.05$, $** = p < 0.01$, $***p < 0.001$

Among those who had ever drank (n=1,281), those residing in the least-deprived areas had reduced odds of weekly drinking compared to those in the most-deprived areas (Odds Ratio=0.64, p=0.048), in fully adjusted models (tables 8.5 and 8.6). Additionally, those in accessible small towns had higher odds of weekly drinking than those in large urban areas (Odds Ratio=2.08, p=0.016). No significant association was found for AODs, neighbourhood level disorder, or neighbourhood social cohesion ($p > 0.05$). Individual perceived disorder was associated with weekly drinking (Odds Ratio=1.14, p=0.011).

Table 8.5: Weekly alcohol consumption regressed neighbourhood and individual measures, among lifetime drinkers (95% credible intervals) (n=1205; Intermediate Data Zones n=190; Schools 148)(Models 1-4).

Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Sex (male)	1.42 (1.10,1.83)**	1.45 (1.11,1.86)**	1.43 (1.10,1.83)**	1.43 (1.10,1.83)**
Age	1.23 (0.78,1.64)	1.19 (0.67,1.98)	1.13 (0.71,1.76)	1.23 (0.92,1.63)
Family Structure (Ref: both parents)				
single parent	1.62 (1.14,2.23)**	1.52 (1.11,2.18)*	1.50 (1.05,2.07)*	1.51 (1.06,2.09)*
step family/other	1.23 (0.81,1.78)	1.20 (0.79,1.74)	1.14 (0.75,1.66)	1.15 (0.76,1.68)
Family Affluence (Ref: low)				
medium	1.12 (0.80,1.53)	1.14 (0.81,1.57)	1.19 (0.84,1.63)	1.19 (0.84,1.64)
high	1.10 (0.79,1.49)	1.14 (0.82,1.55)	1.22 (0.87,1.66)	1.22 (0.87,1.67)
Ethnicity (white)	0.72 (0.27, 1.59)	0.69 (0.27, 1.42)	0.66 (0.24,1.40)	0.68 (0.26,1.46)
On trade licence density		1.00 (0.96,1.05)	1.01 (0.96,1.05)	1.01 (0.96,1.05)
Off trade license density		1.04 (0.93,1.16)	1.00 (0.90,1.12)	1.00 (0.89,1.12)
Urban/rurality (Ref: Large cities)				
other urban		1.24 (0.73,1.99)	1.21 (0.72,1.92)	1.22 (0.72,1.94)
accessible small towns		2.19 (1.24,3.66) **	2.11 (1.22,3.47) **	2.16 (1.23,3.57) **
accessible rural		1.15 (0.65,1.92)	1.19 (0.68,1.97)	1.23 (0.69,2.06)
remote small towns		1.34 (0.76,2.24)	1.23 (0.71,2.03)	1.27 (0.71,2.11)
remote rural		1.34 (0.80,2.15)	1.32 (0.79,2.10)	1.40 (0.79,2.30)
Neighbourhood deprivation (Ref: 1 most deprived)				
2			0.87 (0.57,1.26)	0.89 (0.59,1.29)
3			0.72 (0.47,1.06)	0.74 (0.48,1.09)
4 least deprived			0.59 (0.37,0.89)*	0.60 (0.38,0.91)*
Neighbourhood social cohesion				0.90 (0.44,1.67)
Neighbourhood disorder				
Perceived social cohesion				
Perceived disorder				
Neighbourhood variance	0.18 (0.01,0.44)	0.17 (0.00,0.44)	0.11 (0.00,0.37)	0.12 (0.00,0.38)
School variance				
DIC	1503.53	1509.55	1509.1	1508.99
Residual Moran's I				

Burn-in 5,000; chain 200,000;
DIC=Deviance Information Criterion;
Respondents missing on any predictor or outcome were not included in the models;
$* = p < 0.05$, $** = p < 0.01$, $***p < 0.001$

Table 8.6: Weekly alcohol consumption regressed neighbourhood and individual measures, among lifetime drinkers (95% credible intervals) (n=1205; Intermediate Data Zones n=190; Schools 148) (Models 5-8).

Variable	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Sex (male)	1.43 (1.10,1.84)**	1.43 (1.10,1.84)**	1.44 (1.10,1.86)**	1.44 (1.09,1.86)**
Age	1.26 (0.86,1.70)	1.38 (0.80,2.39)	1.10 (0.75,1.66)	1.22 (0.82,1.54)
Family Structure (Ref: both parents)				
single parent	1.51 (1.06,2.09)*	1.52 (1.06,2.10)*	1.47 (1.02,2.04)*	1.47 (1.03,2.04)*
step family/other	1.15 (0.76,1.67)	1.16 (0.76,1.68)	1.13 (0.74,1.65)	1.13 (0.74,1.66)
Family Affluence (Ref: low)				
medium	1.20 (0.85,1.65)	1.21 (0.85,1.67)	1.25 (0.87,1.73)	1.25 (0.88,1.73)
high	1.22 (0.87,1.67)	1.23 (0.88,1.68)	1.26 (0.89,1.72)	1.26 (0.89,1.73)
Ethnicity (white)	0.72 (0.28, 1.61)	0.71 (0.28, 1.50)	0.66 (0.25, 1.42)	0.66 (0.25, 1.46)
On trade licence density	1.00 (0.96,1.05)	1.00 (0.96,1.05)	1.00 (0.96,1.05)	1.01 (0.96,1.05)
Off trade license density	1.01 (0.90,1.12)	1.01 (0.90,1.13)	0.99 (0.88,1.11)	0.99 (0.88,1.11)
Urban/rurality (Ref: Large cities)				
other urban	1.23 (0.73,1.95)	1.23 (0.73,1.96)	1.25 (0.72,2.01)	1.24 (0.72,2.01)
accessible small towns	2.03 (1.16,3.35)*	2.04 (1.13,3.42)*	2.08 (1.14,3.54)*	2.05 (1.12,3.49)*
accessible rural	1.22 (0.69,2.02)	1.23 (0.68,2.06)	1.28 (0.70,2.19)	1.26 (0.69,2.15)
remote small towns	1.26 (0.71,2.09)	1.26 (0.69,2.13)	1.32 (0.72, 2.25)	1.30 (0.70, 2.24)
remote rural	1.40 (0.82,2.26)	1.41 (0.78,2.35)	1.39 (0.77,2.34)	1.40 (0.78,2.36)
Neighbourhood deprivation (Ref: 1 most deprived)				
2	0.90 (0.60,1.32)	0.89 (0.59,1.31)	0.91 (0.60,1.35)	0.92 (0.60,1.35)
3	0.77 (0.50,1.14)	0.76 (0.49,1.14)	0.80 (0.51,1.21)	0.81 (0.51,1.22)
4 least deprived	0.64 (0.40,0.97)*	0.63 (0.39,0.97)*	0.64 (0.40,1.00)*	0.64 (0.39,1.00)*
Neighbourhood social cohesion		1.07 (0.48,2.10)	1.38 (0.56,2.88)	1.35 (0.55,2.84)
Neighbourhood disorder	2.27 (0.65,5.90)	2.31 (0.58, 6.44)	1.23 (0.25, 3.74)	1.20 (0.25, 3.61)
Perceived social cohesion			.95 (0.89,1.01)	.95 (0.90,1.01)
Perceived disorder			1.14 (1.03,1.27)*	1.15 (1.03,1.27)*
Neighbourhood variance	0.12 (0.00,0.38)	0.12 (0.00,0.40)	0.17 (0.00,0.46)	0.14 (0.00,0.42)
School variance				0.05 (0.00,0.22)
DIC	1508.47	1513.15	1499.86	1500.13
Residual Moran's I				-0.031 (p=0.406)

Burn-in 5,000; chain 200,000;
DIC=Deviance Information Criterion;
Respondents missing on any predictor or outcome were not included in the models;
$* = p < 0.05$, $** = p < 0.01$, $***p < 0.001$

Turning now to drunkenness, among those who had ever drank, those in accessible small towns (Odds Ratio = 2.24, p=0.003) and remote rural areas (Odds Ratio= 2.01, p=0.006) had higher odds of drunkenness than those in large urban areas (tables 8.7 and 8.8), in the fully adjusted models. Those residing in areas of lower deprivation had significantly reduced odds of drunkenness; however, this relationship became non-significant when accounting for neighbourhood level disorder. Neighbourhood level disorder was associated with increased odds of drunkenness; however, this relationship was no longer significant when accounting for neighbourhood social cohesion and individual neighbourhood perceptions.

For all outcomes the associations in Model 7 were still observed after accounting for school level variation. Sensitivity analysis using different distance bands to measure AODs did not influence main findings from the models (see Appendix F). Visual inspection of the trajectory plots indicated good model convergence (the plots reach a stable pattern) (Van de Schoot et al., 2014) on all model parameters except for age; however, this parameter was still included due to its theoretical importance (figure 8.2 and Appendix G).

Because the data are spatially distributed, meaning the dependent variables may not be independent across areas, a global Moran's I was calculated on the IDZ residuals from Model 8 to detect whether there is unaccounted for spatial autocorrelation. The Moran's I statistic was not significant ($p > 0.05$), indicating no spatial clustering in the model residuals; thus suggesting the variables in the model explain spatial variation in drinking outcomes (Anselin and Griffith, 1988).

Table 8.7: Drunkenness regressed on neighbourhood and individual measures, among current drinkers (95% credible intervals) (n=1198; Intermediate Data Zones n=190; Schools 148)(Models 1-4).

Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Sex (male)	0.98 (0.77,1.23)	0.99 (0.77,1.25)	0.98 (0.77,1.24)	0.98 (0.77,1.23)
Age	1.24 (0.76,2.06)	1.00 (0.57,1.54)	1.22 (0.76,1.92)	1.24 (0.78,1.90)
Family Structure (Ref: both parents)				
single parent	1.50 (1.08,2.05)*	1.42 (1.01,1.94)*	1.36 (1.06,1.86)	1.36 (0.97,1.86)
step family/other	2.17 (1.46,3.13) ***	2.07 (1.38,2.99)***	2.02 (1.35,2.93)**	2.01 (1.35,2.92)**
Family Affluence (Ref: low)				
medium	0.87 (0.63,1.16)	0.86 (0.63,1.16)	0.91 (0.66,1.22)	0.91 (0.66,1.23)
high	1.10 (0.81,1.46)	1.16 (0.85,1.54)	1.24 (0.91,1.66)	1.26 (0.92,1.68)
Ethnicity (white)	0.72 (0.25, 1.61)	0.63 (0.23, 1.33)	0.60 (0.22,1.30)	0.64 (0.24,1.33)
On trade licence density		1.03 (0.99,1.08)	1.04 (0.99,1.08)	1.03 (0.99,1.08)
Off trade license density		1.04 (0.94,1.15)	0.99 (0.90,1.11)	0.99 (0.89,1.10)
Urban/rurality (Ref: Large cities)				
other urban		1.07 (0.68,1.60)	1.05 (0.66,1.58)	1.08 (0.68,1.63)
accessible small towns		2.41 (1.44,3.81) **	2.35 (1.40,3.71) **	2.44 (1.46,3.86) **
accessible rural		1.19 (0.73,1.83)	1.25 (0.77,1.92)	1.33 (0.81,2.09)
remote small towns		1.39 (0.85,2.16)	1.31 (0.79,2.05)	1.40 (0.84,2.21)
remote rural		1.67 (1.07,2.49)*	1.74 (1.10,2.62)*	1.99 (1.21,3.09)**
Neighbourhood deprivation (Ref: 1 most deprived)				
2			0.68 (0.45,0.97)*	0.72 (0.48,1.03)
3			0.64 (0.42,0.92) *	0.68 (0.45,0.98) *
4 least deprived			0.60 (0.39,0.87)**	0.64 (0.42,0.94)*
Neighbourhood social cohesion				0.67 (0.35,1.13)
Neighbourhood disorder				
Perceived social cohesion				
Perceived disorder				
Neighbourhood variance	0.09 (0.00,0.30)	0.06 (0.00,0.23)	0.04 (0.00,0.19)	0.03 (0.00,0.13)
School variance				
DIC	1646.49	1638.34	1633.95	1633.01
Residual Moran's I				

Burn-in 5,000; chain 200,000;
DIC=Deviance Information Criterion;
Respondents missing on any predictor or outcome were not included in the models;
$* = p < 0.05$, $** = p < 0.01$, $***p < 0.001$

Table 8.8: Drunkenness regressed on neighbourhood and individual measures, among current drinkers (95% credible intervals) (n=1198; Intermediate Data Zones n=190; Schools 148) (Models 5-8).

Variable	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Sex (male)	0.98 (0.77,1.23)	0.98 (0.77,1.24)	0.99 (0.77,1.25)	1.00 (0.78,1.27)**
Age	1.29 (0.79,1.93)	1.25 (0.87,1.75)	1.18 (0.79,1.58)	1.16 (0.81,1.53)
Family Structure (Ref: both parents)				
single parent	1.37 (0.97,1.89)	1.38 (0.98,1.89)	1.36 (0.96,1.87)	1.35 (1.03,1.87)
step family/other	2.03 (1.36,2.94)**	2.04 (1.36,2.97)**	2.02 (1.36,2.97)**	2.09 (1.38, 3.08)*
Family Affluence (Ref: low)				
medium	0.93 (0.67,1.26)	0.93 (0.67,1.26)	0.94 (0.68,1.26)	0.92 (0.66,1.26)
high	1.27 (0.93,1.71)	1.28 (0.93,1.72)	1.28 (0.93,1.71)	1.27 (0.92,1.72)
Ethnicity (white)	0.65 (0.23,1.40)	0.68 (0.26, 1.47)	0.66 (0.25, 1.41)	0.63 (0.23, 1.35)
On trade licence density	1.03 (0.99,1.07)	1.03 (0.99,1.08)	1.03 (0.99,1.08)	1.03 (0.99,1.08)
Off trade license density	1.00 (0.90,1.11)	1.00 (0.90,1.11)	0.99 (0.89,1.10)	0.99 (0.89,1.11)
Urban/rurality (Ref: Large cities)				
other urban	1.07 (0.68,1.62)	1.09 (0.69,1.66)	1.09 (0.69,1.66)	1.09 (0.69,1.65)
accessible small towns	2.16 (1.28,3.43) **	2.24 (1.31,3.61) **	2.24 (1.31,3.58) **	2.23 (1.24,3.72) **
accessible rural	1.28 (0.78,2.01)	1.34 (0.81,2.11)	1.35 (0.81,2.13)	1.39 (0.80,2.25)
remote small towns	1.35 (0.81,2.11)	1.41 (0.83,2.24)	1.42 (0.84,2.26)	1.46 (0.82,2.42)
remote rural	1.91 (1.19,2.91)**	2.04 (1.23,3.19)**	2.01 (1.21,3.15)**	2.10 (1.21,3.43)**
Neighbourhood deprivation (Ref: 1 most deprived)				
2	0.72 (0.48,1.03)	0.73 (0.49,1.06)	0.75 (0.49,1.07)	0.74 (0.48,1.08)
3	0.71 (0.47,1.04)	0.73 (0.49,1.06)	0.74 (0.48,1.09)	0.73 (0.47,1.09)
4 least deprived	0.68 (0.44,1.00)	0.70 (0.48,1.04)	0.70 (0.45,1.04)	0.69 (0.43,1.04)
Neighbourhood social cohesion		0.88 (0.42,1.62)	0.88 (0.39,1.69)	0.86 (0.37,1.72)
Neighbourhood disorder	3.78 (1.25,9.05)*	3.50 (1.00, 9.10)	2.36 (0.60, 6.54)	2.03 (0.46, 5.80)
Perceived social cohesion			1.00 (0.94,1.06)	1.00 (0.94,1.06)
Perceived disorder			1.09 (0.99,1.19)	1.09 (0.99,1.20)
Neighbourhood variance	0.04 (0.00,0.18)	0.06 (0.00,0.22)	0.05 (0.00,0.22)	0.03 (0.00,0.17)
School variance				0.13 (0.00,0.37)
DIC	1630.61	1631.51	1631.68	1627.2
Residual Moran's I				0.008(p=0.675)

Burn-in 5,000; chain 200,000;
DIC=Deviance Information Criterion;
Respondents missing on any predictor or outcome were not included in the models;
$* = p < 0.05$, $** = p < 0.01$, $***p < 0.001$

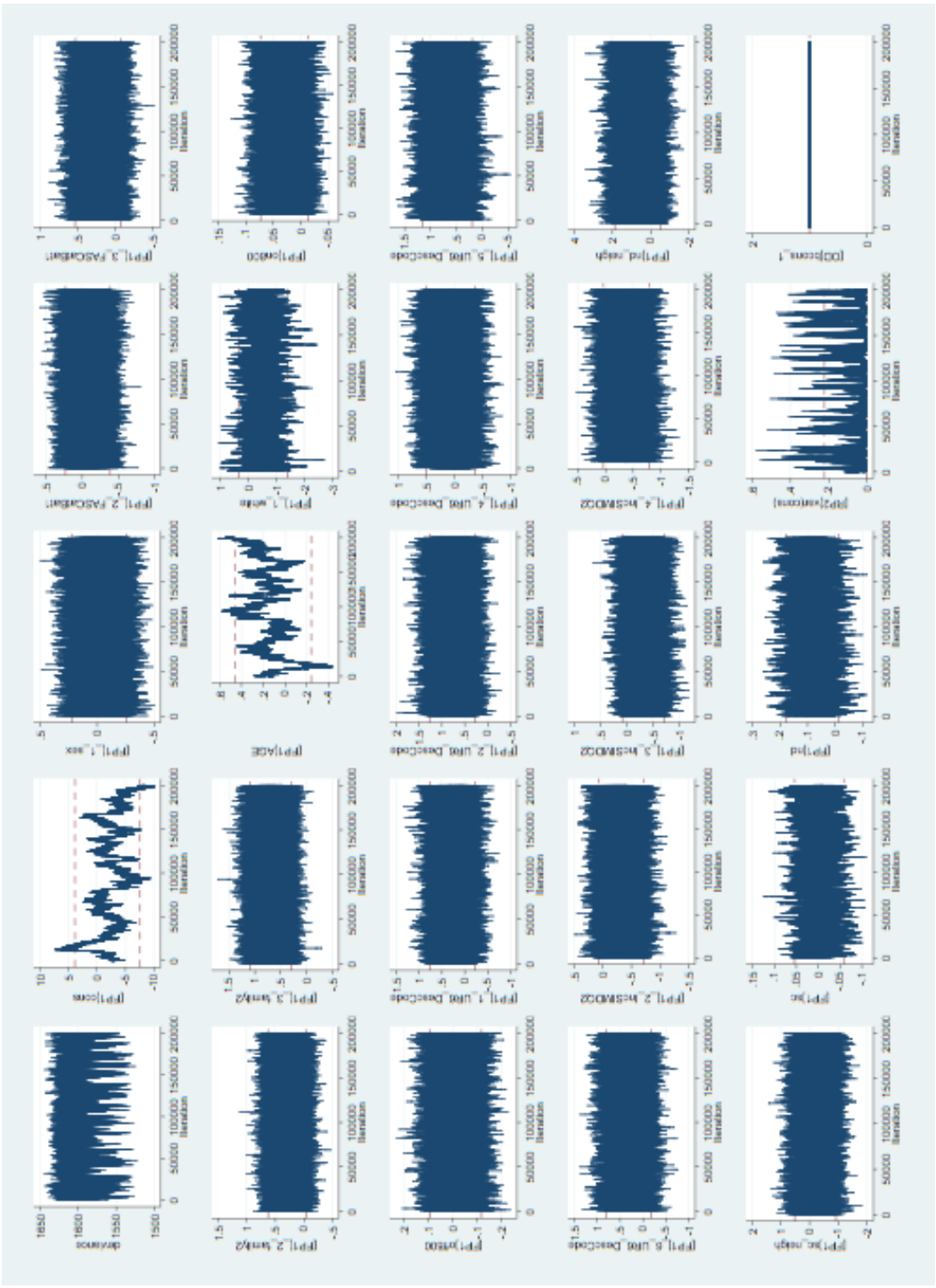

Figure 8.2: Trajectory plots for model 8, outcome is having ever drank

8.3.3.1 Interactions

Few significant interactions were identified between the neighbourhood social characteristics and other neighbourhood conditions or sex, for both random intercepts and random slopes models. When specifying the random slopes models an initial value of 0.01 had to be manually supplied for the variance on the neighbourhood social measure to meet the conditions for the MCMC modelling, as suggested by personal communication with George Leckie (`https://www.cmm.bristol.ac.uk/forum/viewtopic.php?t=2518`). Specifically, the variance-covariance matrix was not positive. Some models were sensitive to model specification; therefore, results should be treated as exploratory.

Although no direct effects were found for neighbourhood level disorder on ever drinking remote rural areas had a stronger effect than urban areas (tables 8.9 and 8.10). The direction of the effect in rural remote areas was negative which is counter to theory (figure 8.3). Urban/rural interactions and off-trade interaction with neighbourhood social cohesion on having ever drunk alcohol were near significance. Remote rural areas had a reduced slope compared to large urban areas which exhibited a stronger negative association between social cohesion and having ever drank. Those residing in areas with more off-trade alcohol outlets and lower social cohesion had greater predicted probability of ever drinking. No significant interactions were found for models where weekly drinking or drunkenness were the outcomes.

Table 8.9: Interaction - Random intercept model beta coefficients (p values)

Interaction	**Ever drank**	**Weekly drinkers**	**Drunkenness**
Social cohesion*		Random Intercepts	
Urban/rurality			
Urban (reference)			
Accessible rural	0.22 (.509)	0.10 (.753)	-0.33(239)
Accessible small town	0.42 (.274)	0.06 (.853)	0.05(.863)
Other urban	0.34 (.292)	0.13 (.679)	-0.23(.417)
Remote rural	0.61 (.052)	0.20 (.491)	-0.21(.401)
Remote small town	0.64 (.138)	-0.11 (.750)	0.11(.729)
Deprivation			
High (reference)			
2	0.07 (.783)	0.29 (.189)	0.04(.843)
3	0.07 (.802)	0.33 (.168)	-0.01(.972)
Low	0.13 (.646)	-0.05 (.827)	0.03(.908)
Off trade AOD	-0.08 (.055)	0.03 (.374)	0.00(.979)
On trade AOD	-0.04 (.087)	0.02 (.244)	0.00 (.813)
Male	-0.02 (.924)	0.04 (.734)	-0.19 (.112)
Neighbourhood disorder*			
Urban/rurality			
Urban (reference)			
Accessible rural	0.13 (.663)	0.01 (.982)	0.14(.529)
Accessible small town	0.50 (.151)	0.07 (.801)	0.24(.379)
Other urban	-0.13 (.647)	-0.30 (.257)	0.01(.959)
Remote rural	-0.54 (.048)*	-0.40 (.112)	0.03(.895)
Remote small town	0.06 (.878)	0.10 (.732)	0.03(.916)
Deprivation			
High (reference)			
2	0.14 (.607)	-0.16(.430)	-0.07(.704)
3	-0.17 (.532)	-0.34(.119)	-0.15(.462)
Low	-0.02 (.938)	-0.03(.900)	0.04 (.835)
Off trade AOD	0.09 (.086)	-0.06 (.163)	-0.02 (.600)
On trade AOD	0.04 (.063)	-0.03 (.172)	0.00 (.866)
Male	-0.18 (.244)	-0.14 (.296)	0.02(.860)

*$p < .05$

Table 8.10: Interactions - Random slope models sensitivity analysis beta coefficients (p values)

Interaction	**Ever drank**	**Weekly drinkers**	**Drunkenness**
Social cohesion*		Random Slopes	
Urban/rurality			
Urban (reference)			
Accessible rural	0.24 (.471)	0.04 (.902)	-0.36 (.213)
Accessible small town	0.43 (.271)	0.04 (.921)	0.05 (.880)
Other urban	0.36 (.274)	0.16 (.671)	-0.20 (.480)
Remote rural	0.62 (.054)	0.17 (.599)	-0.22 (.395)
Remote small town	0.67 (.128)	-0.15 (.709)	0.13 (.667)
Deprivation			
High (reference)			
2	0.08 (.778)	0.29 (.227)	0.06 (.788)
3	0.07 (.807)	0.32 (.206)	0.02 (.938)
Low	0.13 (.645)	-0.08 (.757)	0.04 (.853)
Off trade AOD	-0.09 (.052)	0.03 (.374)	0.00 (.995)
On trade AOD	-0.04 (.089)	0.02 (.242)	0.00 (.817)
Male	-0.02 (.910)	0.06 (.629)	-0.18 (.123)
Neighbourhood disorder*			
Urban/rurality			
Urban (reference)			
Accessible rural	0.13 (.685)	0.04 (.907)	0.16 (.527)
Accessible small town	0.51 (.152)	0.02 (.962)	0.27 (.346)
Other urban	-0.14 (.633)	-0.18 (.579)	0.03 (.892)
Remote rural	-0.57 (.043)*	-0.37 (.214)	0.05 (.837)
Remote small town	0.05 (.898)	-0.05 (.886)	0.07 (.806)
Deprivation			
High (reference)			
2	0.14 (.599)	-0.10 (.635)	-0.09 (.667)
3	-0.18 (.498)	-0.25 (.310)	-0.17 (.421)
Low	-0.02 (.935)	0.09 (.716)	0.02 (.905)
Off trade AOD	0.09 (.083)	-0.07 (.160)	-0.02 (.585)
On trade AOD	0.05 (.062)	-0.03 (.166)	0.00 (.871)
Male	-0.17(.263)	-0.12 (368)	0.03(.833)

*$p < .05$

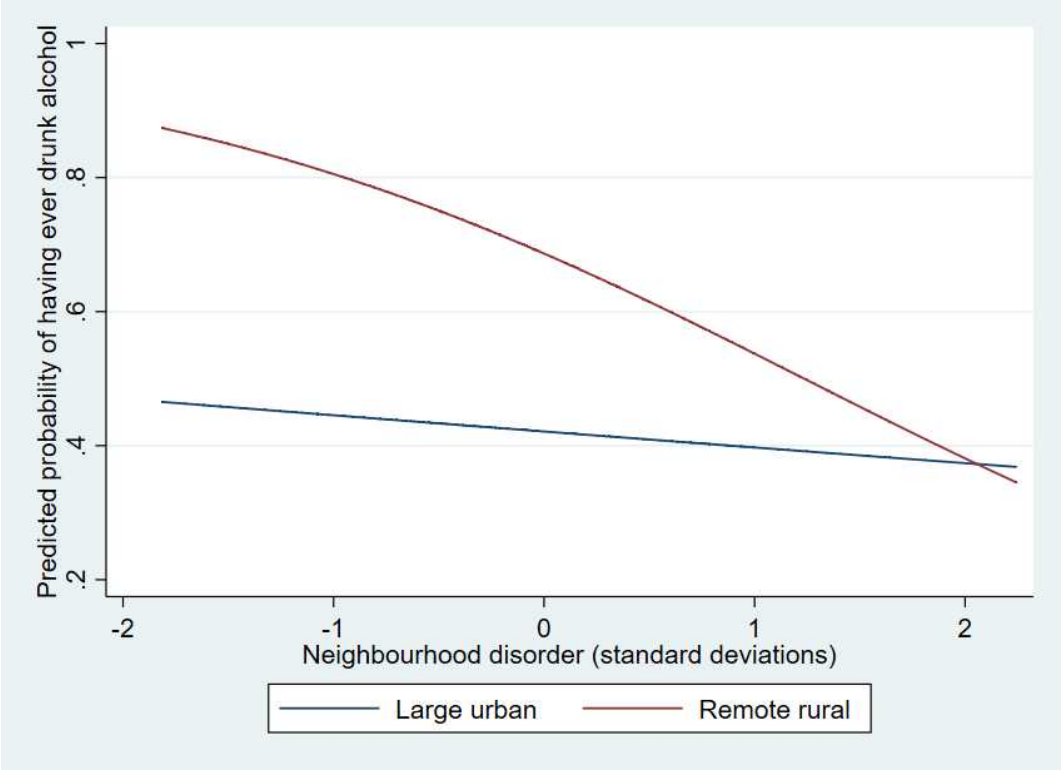

Figure 8.3: Interaction plot showing the relationship between neighbourhood level disorder and having ever drank by large urban and remote rural areas

8.4 Discussion

This study used multilevel analysis to examine associations of neighbourhood characteristics with adolescent drinking behaviours. The results are strengthened by the inclusion of school level variance; thus, testing whether the findings are in fact overestimated due to the omission of the school level. Results show that having ever drank and weekly alcohol use varied by neighbourhood, and are in line with a study of US adolescents that found significant variance of alcohol misuse at the neighbourhood level but not the school level (Ennett et al., 2008). However, school explained a greater amount of variance in drunkenness. This may be due to binge drinking being more influenced by shared peer culture experienced at school (Kuntsche and Jordan, 2006).

The more remote and rural the area an adolescent resided in, the higher the odds of having ever drank. Other studies in Scotland have found an urban/rural difference (using a dichotomous measure) in whether adolescents had ever drank (The Scottish Government, 2016*a*). This research found that among drinkers, those living in accessible small towns had higher odds of weekly drinking and drunkenness and those in remote rural areas had higher odds of drunkenness. This supports the principle that more detailed classifications of urban/rural are necessary, as suggested by Dixon and Chartier (2016). Additionally, the results reflect previous research on adolescent illicit substance and tobacco use, which maintain that adolescent substance use in Scotland is not concentrated in urban areas (Forsyth and Barnard, 1999; Levin et al., 2014). The associations related to urban/rurality remained unexplained after controlling for neighbourhood social conditions and AOD, indicating that there may be other reasons for these inequalities. It may be that in rural areas and accessible small towns, alcohol use may be normalised and used as a form of 'cultural capital' (Kloep et al., 2001).

It is important to note that the sample was made up of 15-year olds; therefore, findings of an urban/rural gradient in having ever drank, represents a more delayed initiation to drinking among urban young people but, does not necessarily translate to

lifetime abstention throughout adulthood. Conversely, many studies have found that, among adults, those in urban areas have higher rates of alcohol use compared to those in rural areas (Dixon and Chartier, 2016; Slutske et al., 2016). Comprehension of different drinking trajectories across the life course, in terms of urban/rurality, is needed to explain this pattern.

Those living in an area of low deprivation had lower odds of weekly drinking, but this was not not the case for having ever drank, or drunkenness (in fully adjusted models). Based on these findings, a potential explanation for the mixed results found in previous studies of neighbourhood socioeconomics and adolescent alcohol use could be due to use of differing alcohol outcomes. Our results are in accordance with other research that found a relationship with neighbourhood deprivation and regular drinking among adolescents in Scotland (Petrou and Kupek, 2018). The current study strengthens that evidence in that it adjusts for other neighbourhood conditions and family factors and confirms that this relationship holds. Also similar to Petrou and Kupek (2018), drunkenness was associated with deprivation; however, when adjusted for social factors much of this relationship is accounted for by neighbourhood level disorder.

Social cohesion was negatively associated with having ever drank by S4 (approximately age 15); however, among those who had ever drank, there was no association with drinking behaviours. This is counter to findings from an urban US study that found neighbourhood collective efficacy did not influence adolescent alcohol use (Fagan et al., 2015). This may be due to measures of the social environment originating from adults rather than adolescents. Conversely, Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga (2016) found collective efficacy, as measured by adolescents, was associated with adolescent drinking outcomes in an urban sample. Our findings support theories which argue that positive social connections discourage adolescent alcohol use; however, the association is limited to alcohol initiation. Early initiation into alcohol use has been linked to higher levels of use in adulthood (Petit et al., 2013) More research is

needed to determine if creating more cohesive communities could reduce the likelihood of adolescents commencing alcohol use.

Unlike previous studies of Scottish adult populations (Shortt et al., 2018) this research did not find an association between AOD and adolescent drinking outcomes. This may be because 15 year olds are unlikely to purchase alcohol directly from retailers due to Scotland's age restrictions and regulations (The Scottish Government, 2016*b*). It is noteworthy that the measure of on-trade outlets did not distinguish between establishment types. These may have differing impacts for adolescents as, unlike adults, they are restricted in terms of alcohol access in these venues. Some establishments would primarily be drinking establishments and may influence social norms in the neighbourhood, while other establishments may serve as a source of entertainment with alcohol consumption not being the primary activity. Moreover, the impact of AOD may only be observed over time after repeat exposure; longitudinal studies are needed to examine this possibility.

Neighbourhood level disorder had no direct effects on having ever drank; however, a significant interaction revealed a negative effect in remote rural areas. One possible explanation is that in remote rural areas where disorder is higher parents may exert greater control over adolescents, given the remote location this may prove effective in reducing access to alcohol. However, caution is needed when interpreting the results of the interactions as differences in model specification did have an impact on some results. Further work is needed to create guidelines for use of interactions in multilevel analyses using Bayesian inference, particularly given the increased interest in the modifying effect of neighbourhood conditions.

This study has several strengths, including having a boosted sample of non-urban youth, accounting for a variety of theoretically important neighbourhood conditions, and adjusting for school-level variation. Some limitations are worth consideration. First, this study is cross-sectional, so causation cannot be inferred. Additionally, IDZs were

used to represent neighbourhoods. However, this is an administrative unit and may not correspond to the respondents' understandings of their neighbourhood boundaries. Moreover, the neighbourhood-level social cohesion and disorder measures are derived from the same adolescents who reported their drinking behaviours, therefore this study is at risk of same-source bias (Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016). Further, this work was unable to examine family structures that did not include a biological parent due to small numbers of students reporting these family compositions. Future studies designed to explicitly examine alcohol consumption among young people in alternative family situations are required. Finally, the focus of this study was on neighbourhood characteristics. Future studies may examine school characteristics. This is of interest for drunkenness given the greater proportion of variance accounted for by school compared to neighbourhood.

Despite these limitations, the results have important implications for public health strategies. Efforts that are targeted to rural areas, small towns, and neighbourhoods with low social cohesion are needed, given higher rates of adolescent alcohol use. Additionally, services and interventions should be directed at regions of high-deprivation in Scotland, due to the higher rates of regular alcohol use. Future work is needed to develop and evaluate intervention and prevention approaches targeted to those neighbourhoods at greatest risk.

Chapter 9

Exploring associations of neighbourhood characteristics with adolescent drinking motives and the potential mediating effects of motives on alcohol use

9.1 Introduction

Adolescents not only vary in their alcohol use behaviour but also in their motivations for drinking (Stapinski et al., 2016). Therefore, it is important to extend the understanding of adolescent drinking beyond patterns and prevalence. It has been hypothesized that drinking motives are more important in adolescence, when drinking habits are forming, compared to adulthood when habits may already be established (Kuntsche et al., 2005). To limit the negative impact of alcohol consumption on adolescents and society it is

crucial to gain knowledge about why adolescents drink, thus allowing for design of effective public health strategies (Simões et al., 2018; Stapinski et al., 2016; ter Bogt et al., 2013). Gaining a better understanding of the extent to which drinking motivations are influenced by neighbourhood contexts can provide a better comprehension of the aetiology of alcohol use.

Drinking motives research is based on the assumption that drinking behaviour is motivated by various needs, and serves different functions of the individual (Kuntsche et al., 2005). Cox and Klinger (1988) developed a Motivational Model for Alcohol Use. This model assumes that people make decisions about whether to drink based on both emotional and rational processes that are based on the change that is expected by consuming alcohol. Drinking motives are often regarded as the final common pathway to alcohol use, which link to various drinking patterns, and may mediate more distal influences.

Drinking motives can be defined as dimensions or factors that encompass multiple reasons for drinking, which are part of the same motivational construct (Kuntsche et al., 2005). Four primary motives appear in the literature examining young people and drinking motives, commonly referred to as: 1) coping, 2) enhancement, 3) social and 4) conformity. These four motives are measured and have been validated for several samples (adults, university students, and adolescents) using a four factor Drinking Motives Questionnaire, known as the DMQ-R (Drinking Motives Questionnaire Revised) developed by Cooper (1994) (Kuntsche et al., 2006; Gilson et al., 2013; Grant et al., 2007). Using this model the motives to drink are categorised by two underlying dimensions: valence (positive or negative forces that attract or detract i.e., pleasantness or utility (Shuman et al., 2013)) and source (internal or external) of the outcomes individuals expect to achieve from alcohol use. In terms of valence, it is theorised that people drink to gain positive outcomes or to avoid negative consequences. In terms of source, internal motives of "enhancement of a desired internal emotional state or by external

rewards such as social approval or acceptance" (ter Bogt et al., 2013, p. 11) also underlie drinking behaviour. The dimensions and source map onto the four motivations as follows:

- Internally generated, positive reinforcement (**enhancement**, i.e., drinking to have fun and get drunk)
- Externally generated, positive reinforcement (**social**, i.e., to better enjoy social gatherings)
- Internally generated, negative reinforcement (**coping**, i.e., to alleviate problems and worries)
- Externally generated, negative reinforcement (**conformity**, i.e., not to feel left out)

The impact of neighbourhood characteristics on adolescent drinking motivations has rarely been empirically tested. A review undertaken by Kuntsche et al. (2006) examined socio-demographic and contextual factors related to drinking motives and found that sex, age, and mental state (i.e., depression), and situation (i.e., drinking at a party) were all related to motivations to drink. The review only found macro-level geographic contextual factors (international differences) identified in the literature and within country regional differences were not identified (Kuntsche et al., 2006). However, some recent evidence suggests that the neighbourhood characteristics that an adolescent is exposed to may impact on their drinking motives. A study of Portuguese adolescents examined whether adolescents self-reported perceptions of their neighbourhood were associated with their motives for drinking. This study found that all four drinking motives were higher when adolescents perceived high levels of night-time entertainment, violence and robberies, and reported that they live in an isolated area. Perceived social cohesion was not associated with any of the drinking motives (Simões et al., 2018).

Moreover, research that examined drinking to cope based on family and individual characteristics found that adolescents from higher socio-economic family backgrounds drank more to increase confidence; while those from families from lower socio-economic backgrounds drank more to cope with low mood (Stapinski et al., 2016). Although these studies suggest there may be an association between neighbourhood characteristics and adolescent drinking motives, they deal only with individual perceptions of the neighbourhood or family background, and so little is known about whether the external observable conditions of where adolescent live are associated with their drinking motives. A study of US adults found that neighbourhood disadvantage was negatively correlated with social motivations for drinking and positively correlated with drinking to cope (forget worries and problems) (Karriker-Jaffe et al., 2016). However, whether these relationships exist among adolescents is unknown. Kuntsche et al. (2005) has suggested that more research is needed to identify sub-groups of young people who have varying drinking motives.

Motivations are often invoked as a potential pathway between neighbourhood characteristics and alcohol use. For example, if a stress induced pathway is underlying the relationship between neighbourhood deprivation or disorder and adolescent alcohol use than coping motivations to drink should be higher among those experiencing high levels of deprivation or disorder; particularly as it is theorised that alcohol is used as a way for some adolescents to deal with the increased stress that comes from living in such an environment (Green et al., 2013; Hill and Angel, 2005). In contrast, if a social contagion pathway is underlying the relationship alcohol and neighbourhood characteristics, local areas where norms are in favour of alcohol would be expected to exhibit higher extrinsic motivations (social and conformity). Despite these theorised relationships and suggestive evidence, there are few studies that have examined the pathways through which neighbourhoods may impact alcohol use, and calls have been made for further research to investigate drinking motivations as a potential mediator in the relationships between

neighbourhoods and alcohol outcomes (Karriker-Jaffe et al., 2016). Accordingly, the research presented in this Chapter will examine motivations for alcohol use as an outcome of neighbourhood characteristics and then based on these findings, examine the role of motivations as a potential mediator in the relationship between neighbourhood conditions and adolescent alcohol use.

Research questions:

1. Are characteristics of the neighbourhood associated with adolescent drinking motivations?

2. If so, is there evidence that motivations mediate the relationship between neighbourhood conditions and adolescent drinking behaviours?

9.2 Methods

9.2.1 Sample

This analysis was conducted on a subset of the data used in Chapter 8, as the motivation for drinking scale is only asked of students who responded that they had drunk alcohol in the past 12 months; therefore students were only included if they had ever tried alcohol (more than a small amount) and had drank in the past twelve months (n=1119) (figure 9.1).

9.2.2 Measures

9.2.2.1 Drinking motives

The outcomes and potential mediators of interest are the four drinking motivations. The HBSC survey uses a reduced drinking motives model because the high number of items (20 in total) restrict the practical use of the original DMQ-R in surveys that collect data on a wide range of health behaviours. In such surveys, specific topics such

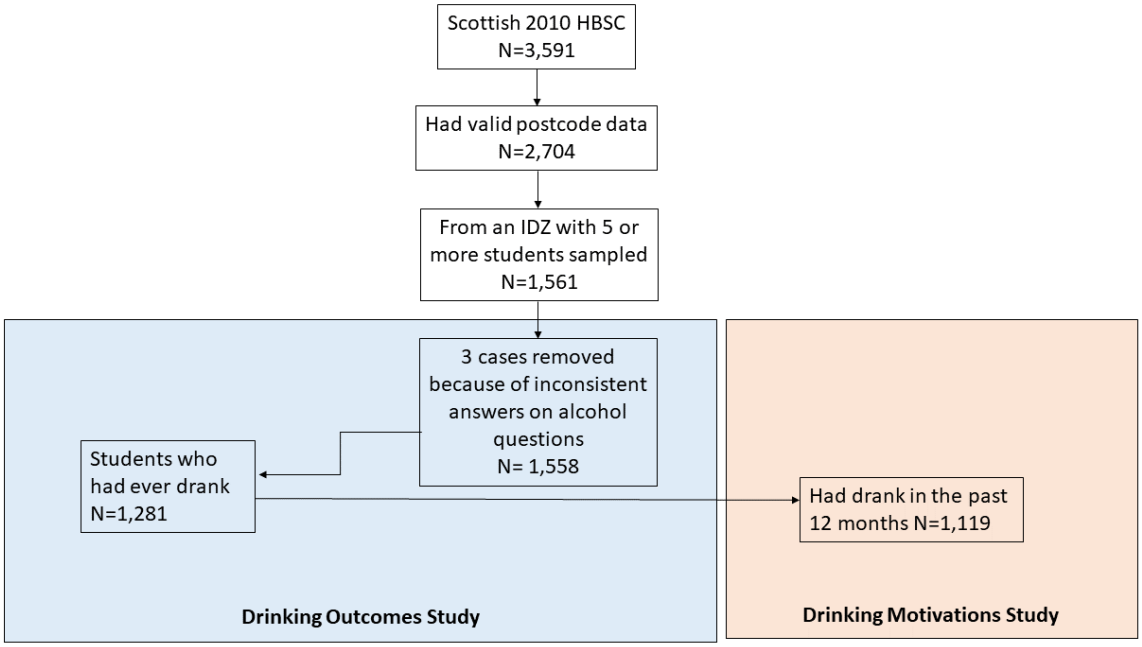

Figure 9.1: Participant inclusion flowchart, drinking motives

as drinking motives can only be realistically integrated in a relatively short form (ter Bogt et al., 2013). To meet this need, a short form Drinking Motivations Questionnaire was developed and validated by Kuntsche and Kuntsche (2009). In this revised version, each of the four dimensions are measured using three items assessed on a 5-point Likert scale: (almost) never (1), some of the time (2), about half of the time (3), most of the time (4), and (almost) always (5). The average of each scale was used in analysis. This questionnaire has been validated in previous research (Kuntsche et al., 2014), and the short form version of the DMQ-R has been found to be equivalent to the DMQ-R long form in terms of validity and consistency (Harbke et al., 2017).

Imputations were carried out in cases where one motivation question was missing on the scale, using the person- scale average (enhancement=45 cases (4 percent); social=20 cases (1.8 percent); conformity=6 cases (0.5 percent); coping= 4 cases (0.4 percent)). Cases with more than one motivation question missing on each scale were not included

in analysis. Cronbach's alphas show good reliability, as follows: enhancement=.798, social =.925; conformity=.854, coping=.898).

All motives were log-transformed to reduce skew and approximate a normal distribution. This was done after preliminary examination found that the residuals in the full models were not normally distributed. Descriptive statistics are reported on the motivations before transformation, as with previous research (Kuntsche and Stewart 2009).

9.2.2.2 Demographics

Sex was included as a covariate as previous studies have found differences between boys and girls on several of the drinking motives (Kuntsche and Jordan, 2006). There is also evidence that drinking to cope varies by family socio-economic condition (Stapinski et al., 2016) so family affluence was included as a covariate. Family structure was also included as there is some indication that the family environment may influence drinking motives (Chalder et al., 2005; Mares et al., 2013).

Age was not included as a covariate as all the adolescents were in the same grade and, unlike for drinking outcomes, there is no hypothesised reason that drinking motivations vary due to small differences in age (correlations between age and the drinking motives were all non-significant $p > 0.05$). Ethnicity was also not included as the numbers of non-white students were small in the reduced sample with full covariates ($n < 20$). No significant differences in means by ethnicity were detected in bi-variate analysis ($p > 0.05$) (t-tests of the drinking motives comparing white and non-white pupils; unequal variances were assumed based on results of Levene's test of equal variances).

9.2.2.3 Neighbourhood characteristics

Neighbourhood deprivation was examined as previous work in adult populations has shown an impact of neighbourhood socio-economic conditions on why people drink

(Karriker-Jaffe et al., 2016).

Urban/rurality as well as on-trade and off-trade alcohol outlet density (at 800 metres surrounding the home postcode) were included as previous research has found self-report of neighbourhood night time entertainment venues and living in an isolated area to be associated with drinking motives (Simões et al., 2018). However, unlike previous work, this research utilises administrative data rather than perceptions.

Neighbourhood-level measures of social cohesion and neighbourhood disorder were included, to determine if these conditions are associated with drinking motives. Individual perceptions were also included to determine if the neighbourhood conditions are related to drinking motivations when accounting for individual perceptions.

9.3 Analysis

Analysis was conducted in two stages 1) examining motivations as the outcome and 2) exploring for potential mediation of motivations on alcohol use. In the first stage, associations with neighbourhood characteristics and drinking motives were assessed using multilevel regression modelling. Empty models were tested to examine the variation of drinking motives across neighbourhoods (IDZs). A model controlling for demographics and family characteristics (sex, family affluence, and family structure) (Model 1) was conducted. Neighbourhood characteristics were then included in a subsequent model (Model 2). Individual neighbourhood perceptions were adjusted for in a final model (Model 3). These analyses were conducted using runmlwin in Stata and MLWin using methods that mirrored those in Chapter 8, with the exception that a linear relationship was specified given that the drinking motives are continuous. Burn-in was 5000 and chain 200 000 (based on the Raftery-Lewis and visual inspection of trajectory plots (see Appendix H) with initial values from maximum likelihood estimation. Assumptions for using a linear regression model were evaluated by visual inspection of plots of residuals versus predicted values to examine for heteroskedasticity, residual Q-norm plots

on the full models to test for normality, and Moran's I calculated for residuals at the neighbourhood level to examine for observation independence.

Second, based on the findings of the models (where neighbourhood characteristics were associated with specific drinking motives) potential mediation of the drinking motives on the relationship between neighbourhood characteristics and drinking outcomes were explored. This was conducted using Mplus. Multivariable path analysis examined the potential mediating pathways of drinking motives on the relationship between neighbourhood exposures and alcohol use. As recommended, a range of measures were used to assess model fit; comparative fit index (CFI)$>$ 0.95, root mean-square error of estimation (RMSEA)$<$ 0.06, and Tucker Lewis index (TLI)$>$ 0.95 (Geiser, 2012). Analysis was conducted using the COMPLEX sub-command to account for clustering by neighbourhood (IDZ) (Geiser, 2012). The MODEL INDIRECT sub-command was used to estimate indirect effects and their standard errors (Karriker-Jaffe et al., 2016). A multilevel path analysis was not employed as indirect effects cannot be estimated using this approach.

The weighted least squares means and variance (WLSMV) estimator in Mplus was used, as this is a robust estimator that does not assume normality and allowed for fit indices and indirect effects, and as the model contained both continuous and categorical variables (Karriker-Jaffe et al., 2016). This estimator is based on probit regression using an inverse normal link function for categorical outcomes and linear regression for continuous outcomes. All paths were controlled for all demographic and neighbourhood exposure variables. To find the most parsimonious model and preserve degrees of freedom for the data, paths on variables where p$>$ 0.10 were removed (Karriker-Jaffe et al., 2016). Results are reported as unstandardised path coefficients with standard errors (SE).

9.4 Results

Social motives were the most commonly reported drinking motive (mean=3.09; SE=0.04), followed by enhancement (mean=2.38; SE=0.03), coping (mean=1.74; SE=0.03), and conformity (mean=1.40; SE=0.02).

9.4.1 Empty models

Null models (table 9.1) revealed that coping motives varied significantly by IDZ (improved Bayesian DIC from when including the neighbourhood level, and z-score test was significant (p=0.038)) with 5.2 percent of variation being explained by the neighbourhood in which adolescents reside. A cross-classified model was also specified for coping motives accounting for school level variance, which reduced the percent of variance accounted for by neighbourhood to 2.9 percent and Bayesian DIC improved (1627.80 versus 1633.47). Enhancement motives had 1.9 percent of variation explained by the neighbourhood in which adolescents resided and a very small improvement in Bayesian DIC was found (difference= 0.48). The other two drinking motives had < 1.5 percent of variation explained by neighbourhood and the addition of the neighbourhood level did not improve Bayesian DIC.

Table 9.1: Empty models examining drinking motives across neighbourhoods (Intermediate Data Zones) (95% credibility intervals)

	Social	**Enhancement**	**Coping**	**Conformity**
Neighbourhood level variance	0.004 (0.000,0.012)	0.005 (0.001,0.014)	0.014 * (0.002,0.028)	0.002 (0.000,0.006)
Individual level variance	0.254 (0.233,0.277)	0.242 (0.221,0.264)	0.246 (0.224,0.270)	0.156 (0.144,0.170)
Neighbourhood % of variance accounted for	1.3%	1.9%	5.2%	1.2%
Improvement in Bayesian DIC with neighbourhood inclusion	No	Yes	Yes	No
DIC -1 level model	1645.62	1586.56	1646.82	1098.83
DIC -2 level model	1646.59	1586.08	1633.47	1101.18

Burn-in 5,000; chain 200,000; Bayesian Deviance Information Criteria is used to examine for model fit improvement in single level compared to multi-level models; * $p < 0.05$ z score test; motivations are log-transformed.

9.4.2 Multivariable models

Although null models supported that coping and, to some degree, enhancement motives were the only motivations to vary across neighbourhoods, further models were still conducted on all four motives to examine the associations between demographics and perceived neighbourhood conditions on these motivations, as previous work has found perceived neighbourhood conditions are predictive of adolescent drinking motives (Simões et al., 2018).

In models not adjusted for neighbourhood characteristics (Model 1), males had lower coping motives than females and those from single parent families had higher coping motives compared to those from two parent families (table 9.2, Model 1). In fully adjusted models (Table 9.2, Model 3) males had lower coping motivations (β=-0.17, p=< 0.001) but family structure was no longer significant (p> 0.05). Coping motives are approximately 16 percent lower in males than females, based on the geometric mean. Residing in an accessible small town was positively associated with coping motivations (β=0.14, p=0.048, approximately 15 percent higher) compared to those in urban regions. Additionally, those residing in the least income deprived areas (β=-0.16 ,p=0.003, approximately 15 percent lower) and the less income deprived areas (β=-0.14 ,p=0.005, approximately 15 percent lower) had lower coping motivations, compared to those in the most deprived areas. Those in the third category of deprivation also had reduced coping motives but this finding only neared significance (p=0.055) when accounting for individual neighbourhood perceptions. Neighbourhood disorder was positively associated with coping motivations, but when adjusting for perceptions of the neighbourhood this was no longer significant (Table 9.2, Models 2 and 3). Perceptions of disorder were positively associated with coping motivations (β=0.03, p=0.035). A 1 unit increase in perceived neighbourhood disorder was associated with about a 3 percent increase in coping motives. Including school level variance by specifying a cross-classified model made little difference to the results (coefficients and p–value did not vary substantially)

(see Appendix I)

When examining social motives for drinking, only perceived neighbourhood disorder was significantly associated with social motivations (β=0.03, p=0.030)(table 9.3). Perceived disorder was also positively associated enhancement motivations (β=0.03, p=0.039). Additionally, enhancement motivations were positively associated with family structure, with students from single parent families having greater enhancement motivations compared to those living in two biological parent families (β=0.10,p=0.021, approximately 11 percent higher) (table 9.4). Conformity motives were higher for males than females (β=0.05, p=0.033, approximately 5 percent higher) and lower in the second most income deprived neighbourhood category compared to those in most deprived (β=-0.10, p=0.010) (table 9.5).

In terms of residual diagnostics, Moran's I show no significant autocorrelation between neighbourhood residuals indicating that spatial autocorrelation is not of concern in these models. The Q-norm plots (Appendix J) show that the residuals are still somewhat skewed despite log-transforming the motives. However, linear regression approaches tend to be fairly robust in terms of the normality assumption, unless using the model to predict specific data points (Gelman and Hill, 2006).

Table 9.2: Coping motivations regressed on neighbourhood and individual measures (95% credible intervals) n=1,046 (Intermediate Data Zones n=188).

Predictor variable	Model 1	Model 2	Model 3
Sex (male) Ref: female	-0.18 (-0.24,-0.12) ***	-0.18 (-0.24,-0.12) ***	-0.17 (-0.24,-0.11) ***
Family Structure (Ref: both parents)			
single parent	0.09 (0.01,0.17) *	0.08(-0.00,0.16)	0.07(-0.01,0.15)
step family/other	0.04(-0.05,0.13)	0.04(-0.06,0.13)	0.04(-0.06,0.13)
Family Affluence (Ref: low)			
medium	-0.07(-0.14,0.01)	-0.04(-0.12,0.03)	-0.04(-0.12,0.04)
high	-0.06(-0.13,0.02)	-0.02(-0.10,0.05)	-0.02(-0.09,0.06)
On trade licence density		0.00(-0.01,0.01)	0.00(-0.01,0.01)
Off trade license density		-0.01(-0.04,0.02)	-0.01(-0.04,0.01)
Urban/rurality (Ref: Large cities)			
other urban		0.06(-0.06,0.19)	0.07(-0.05,0.20)
accessible small towns		0.14 (0.00,0.28) *	0.14 (0.00,0.28) *
accessible rural		0.08(-0.05,0.21)	0.08(-0.05,0.21)
remote small towns		0.11(-0.03,0.24)	0.11(-0.02,0.25)
remote rural		0.03(-0.10,0.16)	0.02(-0.11,0.15)
Neighbourhood deprivation (Ref: 1 most deprived)			
2		-0.14 (-0.24,-0.05) **	-0.14 (-0.24,-0.04) **
3		-0.11 (-0.21,-0.01) *	-0.10(-0.20,0.00)
4 least deprived		-0.17 (-0.27,-0.06) **	-0.16 (-0.27,-0.06) **
Neighbourhood social cohesion		0.05(-0.13,0.23)	0.10(-0.10,0.29)
Neighbourhood disorder		0.39 (0.09,0.68) *	0.26(-0.06,0.58)
Perceived social cohesion			-0.01(-0.02,0.00)
Perceived disorder			0.03 (0.00,0.05) *
Neighbourhood variance	0.017(0.005,0.032)	0.014 (0.003,0.028)	0.014 (0.003,0.027)
Individual variance	0.231 (0.210,0.254)	0.228 (0.207,0.251)	0.226 (0.206,0.249)
Bayesian DIC	1492.90	1482.52	1476.68
Residual Moran's I			.0190(p=.449)

Burn-in 5,000 chain length 200,000; DIC=Deviance Information Criteria; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; coping is log-transformed.

Table 9.3: Social motivations regressed on neighbourhood and individual measures (95% credible intervals) n=1,051 (Intermediate Data Zones n=188).

Predictor variable	Model 1	Model 2	Model 3
Sex (male)	0.01(-0.05,0.07)	0.01(-0.05,0.08)	0.02(-0.04,0.08)
Family Structure (Ref: both parents)			
single parent	0.07(-0.01,0.16)	0.06(-0.03,0.14)	0.05(-0.03,0.14)
step family/other	0.07(-0.03,0.16)	0.05(-0.05,0.15)	0.06(-0.04,0.15)
Family Affluence (Ref: low)			
medium	-0.06(-0.14,0.02)	-0.04(-0.12,0.04)	-0.05(-0.13,0.03)
high	-0.01(-0.09,0.06)	0.01(-0.07,0.09)	0.00(-0.08,0.08)
On trade licence density		-0.00(-0.01,0.01)	-0.00(-0.01,0.01)
Off trade license density		0.02(-0.01,0.05)	0.02(-0.01,0.05)
Urban/rurality (Ref: Large cities)			
other urban		-0.03(-0.15,0.09)	-0.03(-0.15,0.09)
accessible small towns		0.08(-0.05,0.21)	0.08(-0.05,0.21)
accessible rural		-0.03(-0.15,0.10)	-0.03(-0.15,0.10)
remote small towns		0.01(-0.12,0.14)	0.01(-0.12,0.14)
remote rural		-0.02(-0.14,0.11)	-0.02(-0.15,0.11)
Neighbourhood deprivation (Ref: 1 most deprived)			
2		-0.01(-0.11,0.09)	-0.00(-0.10,0.09)
3		-0.02(-0.12,0.09)	-0.01(-0.11,0.09)
4 least deprived		-0.04(-0.15,0.06)	-0.04 (-0.14,0.07)
Neighbourhood social cohesion		0.08(-0.09,0.25)	0.05(-0.14,0.23)
Neighbourhood disorder		0.21(-0.06,0.49)	0.07(-0.23,0.37)
Perceived social cohesion			0.01(-0.01,0.02)
Perceived disorder			0.03 (0.00,0.05) *
Neighbourhood variance	0.004 (0.000,0.013)	0.004 (0.000,0.012)	0.004 (0.000,0.012)
Individual variance	0.253 (0.231,0.276)	0.252 (0.231,0.275)	0.252 (0.230,0.275)
Bayesian DIC	1559.11	1566.44	1565.53
Residual Moran's I			.0215(p=.404)

Burn-in 5,000 chain length 200,000; DIC=Deviance Information Criteria; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; social motivation is log-transformed.

Table 9.4: Enhancement motivations regressed on neighbourhood and individual measures (95% credible intervals) n=1,045 (Intermediate Data Zones n=188).

Predictor variable	Model 1	Model 2	Model 3
Sex (male)	0.01(-0.05,0.07)	0.01(-0.05,0.07)	0.01(-0.05,0.07)
Family Structure (Ref: both parents)			
single parent	0.11 (0.03,0.20) **	0.10 (0.02,0.18) *	0.10 (0.01,0.18) *
step family/other	0.08(-0.01,0.17)	0.07(-0.02,0.16)	0.07(-0.02,0.17)
Family Affluence (Ref: low)			
medium	-0.00(-0.08,0.08)	0.02(-0.06,0.09)	0.02(-0.06,0.10)
high	0.02(-0.06,0.09)	0.04(-0.03,0.12)	0.04(-0.04,0.11)
On trade licence density		-0.00(-0.01,0.01)	-0.00(-0.01,0.01)
Off trade license density		0.03(-0.00,0.06)	0.02(-0.00,0.05)
Urban/rurality (Ref: Large cities)			
other urban		-0.03(-0.15,0.08)	-0.03(-0.15,0.09)
accessible small towns		0.06(-0.07,0.19)	0.06(-0.07,0.19)
accessible rural		0.03(-0.10,0.15)	0.03(-0.10,0.15)
remote small towns		-0.05(-0.18,0.08)	-0.05(-0.17,0.08)
remote rural		0.04(-0.09,0.16)	0.03(-0.09,0.16)
Neighbourhood deprivation (Ref: 1 most deprived)			
2		-0.07(-0.17,0.03)	-0.07(-0.17,0.03)
3		-0.05(-0.15,0.05)	-0.05(-0.14,0.05)
4 least deprived		-0.05(-0.15,0.06)	-0.04(-0.15,0.06)
Neighbourhood social cohesion		0.04(-0.13,0.21)	0.04(-0.14,0.22)
Neighbourhood disorder		0.24(-0.04,0.50) †	0.10(-0.19,0.40)
Perceived social cohesion			-0.00(-0.01,0.01)
Perceived disorder			0.03 (0.00,0.05) *
Neighbourhood variance	0.005(0.000,0.014)	0.005(0.001,0.015)	0.005(0.001,0.014)
Individual variance	0.237(0.217,0.259)	0.236(0.215,0.259)	0.236(0.215,0.257)
Bayesian DIC	1486.32	1491.99	1491.21
Residual Moran's I			0.0393(p=.166)

Burn-in 5,000 chain length 200,000; DIC=Deviance Information Criteria; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; enhancement motivation is log-transformed.

Table 9.5: Conformity motivations regressed on neighbourhood and individual measures (95% credible intervals) n=1,048 (Intermediate Data Zones n=188)

Predictor variable	Model 1	Model 2	Model 3
Sex (male)	0.05 (0.00,0.10) *	0.05 (0.00,0.10) *	0.05 (0.01,0.10) *
Family Structure (Ref: both parents)			
single parent	-0.04(-0.10,0.03)	-0.04(-0.10,0.03)	-0.04(-0.10,0.03)
step family/other	0.02(-0.05,0.09)	0.02(-0.05,0.10)	0.02(-0.05,0.10)
Family Affluence (Ref: low)			
medium	-0.01(-0.07,0.05)	-0.00	
(-0.07,0.06)	-0.01(-0.07,0.06)		
high	-0.01(-0.07,0.05)	-0.00	
(-0.06,0.06)	-0.01(-0.07,0.06)		
On trade licence density		-0.00	
(-0.01,0.01)	-0.00(-0.01,0.01)		
Off trade license density		0.01	
(-0.02,0.03)	0.01(-0.02,0.03)		
Urban/rurality (Ref: Large cities)			
other urban		0.02	
(-0.07,0.12)	0.02(-0.07,0.11)		
accessible small towns		0.03	
(-0.07,0.14)	0.03(-0.07,0.14)		
accessible rural		0.07(-0.03,0.17)	0.07(-0.03,0.17)
remote small towns		0.03(-0.07,0.13)	0.03(-0.07,0.13)
remote rural		0.04(-0.05,0.14)	0.04(-0.06,0.14)
Neighbourhood deprivation (Ref: 1 most deprived)			
2		-0.10 (-0.18,-0.03) *	-0.10 (-0.18,-0.02) *
3		-0.05(-0.12,0.03)	-0.04(-0.12,0.04)
4 least deprived		-0.07(-0.15,0.01)	-0.07(-0.15,0.02)
Neighbourhood social cohesion		0.04(-0.09,0.17)	0.01(-0.13,0.16)
Neighbourhood disorder		0.02(-0.19,0.24)	-0.03(-0.27,0.21)
Perceived social cohesion			0.00(-0.01,0.02)
Perceived disorder			0.01(-0.01,0.03)
Neighbourhood variance	0.002(0.000,0.006)	0.002(0.000,0.007)	0.002(0.000,0.007)
Individual variance	0.154(0.141,0.168)	0.154(0.141,0.168)	0.154(0.141,0.168)
Bayesian DIC	1029.99	1043.24	1045.74
Residual Moran's I			0.003 (p=.792)

Burn-in 5,000 chain length 200,000; DIC=Deviance Information Criteria; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; conformity motivation is log-transformed.

9.4.3 Path analysis

Path analysis was only carried out examining coping as a potential mediator because of the significant variation across neighbourhoods and the observed associations between neighbourhood conditions. Because neighbourhood deprivation and living in an accessible small town were significantly associated with both weekly drinking (see Chapter 8) and coping motivations, post-hoc analysis was conducted whereby a direct and indirect path model was specified: deprivation → coping → weekly drinking and accessible small town → coping → weekly drinking. Additionally, as perceived disorder may explain the relationship between neighbourhood disorder and coping motivations an indirect pathway was specified: neighbourhood disorder → perceived disorder → coping → weekly drinking. The hypothesised pathways are depicted in figure 9.2 and based on findings from the above sections and Chapter 8. Correlations were specified between neighbourhood disorder and neighbourhood deprivation as well as neighbourhood disorder and urban/rurality, but these were excluded in the final model as inclusion had a negative impact on model fit. A direct effect was not included from neighbourhood disorder to weekly alcohol use based on the finding from Chapter 8 that no significant relationship existed. Models controlled for family structure and sex. Family affluence was excluded as its inclusion had a negative effect on model fit and it was not significantly associated with any outcome variable in the model.

Table 9.6 shows the results from the path analysis (n=1,032). As hypothesised, neighbourhood disorder was associated with individual perceived disorder (β=5.09, p< 0.001). Additionally, coping motives to drink were associated with weekly drinking (β=0.66, p< 0.001). When accounting for coping motives, neighbourhood deprivation and living in an accessible small town were not significantly associated with weekly drinking (p> 0.05). Significant relationships were found previously (see Chapter 8) when not adjusting for coping motivations, indicating a potential indirect effect. To test whether this could be because of small differences in the sample and covariates

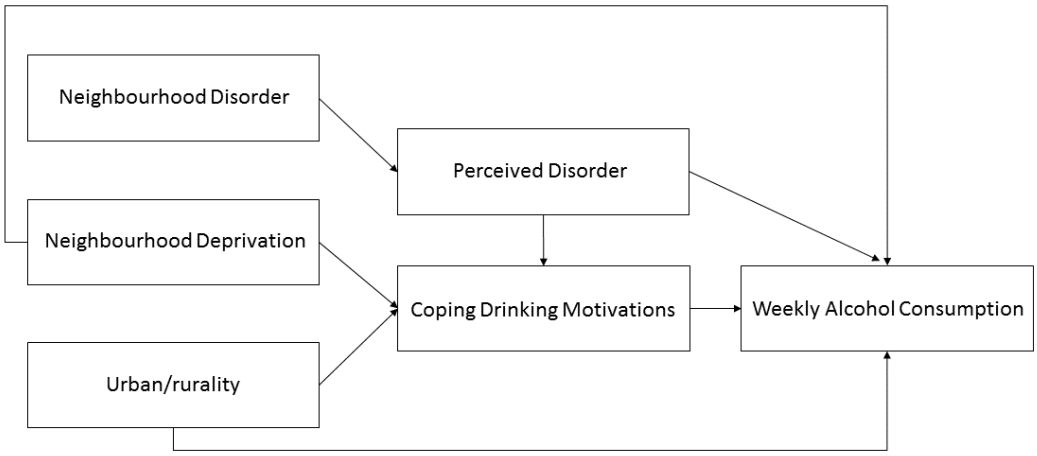

Figure 9.2: Hypothesised path model of neighbourhood conditions on Scottish adolescent weekly alcohol consumption

a sensitivity analysis was carried out removing coping motives from the path model. Neighbourhood deprivation and accessible small towns became significant ($p< 0.05$) in this model. Figure 9.3 shows the significant paths from the path analysis with non-significant paths from the hypothesised model removed. CFI and RMSEA indicated good model fit was achieved; however; the TLI =0.92 and did not meet the cut-off of 0.95.

9.4.3.1 Indirect effects

No direct effects were found from neighbourhood deprivation on weekly alcohol consumption when accounting for coping motivations ($p> 0.05$ for all categories of deprivation). However, an indirect effect was present for those residing in the least deprived areas (β=-0.11, SE=0.04, p=0.002) and the second most deprived category (β=-0.09, SE=0.03, p=0.002) through coping motives to weekly drinking. The effect was also indi-

Table 9.6: Unstandardized coefficients (standard errors) for path models.

	Per. disorder	**Coping motive**	**Weekly Drinking**
Demographics			
Male	-0.14 (0.08)	0.16 (0.03)***	0.32 (0.09)***
Family Structure (Ref: both parents)			
Single parent family	0.15 (0.11)	0.08 (0.04)*	0.21 (0.09)*
Other	-0.06 (0.12)	0.04 (0.05)	0.03 (0.12)
Neighbourhood Conditions			
Neighbourhood deprivation (Ref: 1 most deprived)			
2		-0.14(0.04)**	0.01 (0.12)
3		-0.09 (0.05)	-0.13 (0.12)
4 least deprived		-0.17 (0.05)**	-0.22 (0.13)
Urban/rurality (Ref: Large cities)			
other urban		0.08 (0.07)	0.11 (0.16)
accessible small towns		0.15 (0.07)*	0.28 (0.15)
accessible rural		0.10 (0.07)	-0.05 (0.15)
remote small towns		0.11 (0.07)	-0.01 (0.16)
remote rural		0.06 (0.06)	0.11 (0.15)
Neighbourhood disorder	5.09 (0.22)***		
Potential Mediators			
Perceived disorder		0.03 (0.01)***	0.06 (0.03)*
Coping motives			0.66 (0.07)***

Fit statistics: estimated degrees of freedom=39; CFI=0.979; TLI=0.920; RMSEA=0.032; coping motives are log transformed; *p< 0.05; ** $p < 0.01$; ***$p < 0.01$.

rect for those living in an accessible small town (β=-0.10, SE=0.05, p=0.037) through coping motives to weekly drinking. Moreover, significant indirect effects were found from neighbourhood disorder through neighbourhood perceptions (β=0.30, SE=0.13, p=0.022) and through coping motivations (β=0.12, SE=0.3, p< 0.001).

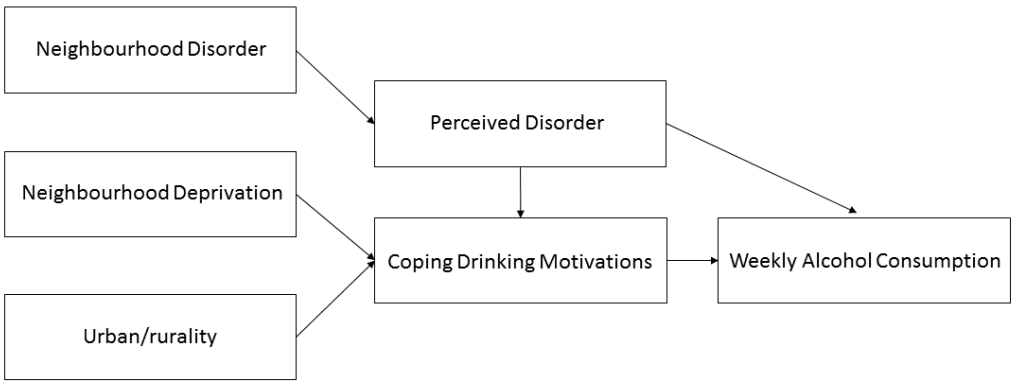

Figure 9.3: Path analysis with insignificant paths removed (n=1,032)

9.5 Discussion

In line with past research, Scottish adolescents reported alcohol use for social motives most frequently, followed by enhancement, coping, and conformity (Simões et al., 2018; Kuntsche et al., 2005, 2014). Sex differences were only found for negative valence motives. Differences in coping motivations are consistent with previous research from Cooper (1994) who found girls scored higher than boys in coping motivations in early adolescence (13-15 years) but among 18-19-year olds the reverse was found. Boys had higher conformity motivations, which is also consistent with previous cross-cultural studies. Gender differences are largely thought to be due to differences in personality traits with adolescent females being more anxiety sensitive than males and males being more extroverted and impulsive (Kuntsche et al., 2014).

This study aimed to test whether neighbourhood conditions were associated with drinking motives and whether drinking motives mediate the link between neighbour-

hood conditions and drinking outcomes. There was little variation evident in social, enhancement, and conformity motivations by neighbourhood. There is little reason to expect enhancement to vary across neighbourhoods, so this is not a surprising finding. However previous work with adults found that neighbourhood affluence was associated with social motives (Karriker-Jaffe et al., 2016); findings of the present study indicate that such associations are not present in adolescents. Social motives are highly reported among adolescents, across different cross-cultural contexts. Social motives appear to be equally important across various neighbourhood conditions for Scottish adolescents.

Considering, the lack of variation across neighbourhoods in social, enhancement, and conformity motives, it is not unexpected that few neighbourhood characteristics were associated with these motivations. One exception is that those in the second most deprived neighbourhood category had lower conformity motivations than those in the most deprived areas. This may be because those residing in the most deprived neighbourhoods may be more susceptible to peer group pressures (Brooks-Gunn et al., 1993). However, those in the least deprived neighbourhoods did not have the lower conformity motives; it may be that pressure to conform to drinking practices is related in a non-linear fashion to neighbourhood deprivation. Based on these findings there is little evidence that neighbourhood conditions impact on adolescents' positive valence, and the impact is also limited for conformity motives. Drinking to cope was the only motivation to show significant variation across neighbourhoods. Therefore, only coping motives were considered as a possible mediator between neighbourhoods and drinking outcomes.

Those living in more deprived areas experienced higher coping motivations. This is in line with Karriker-Jaffe et al.'s 2016 findings that adults in deprived neighbourhoods report more coping motives for alcohol use. The higher levels of coping motivations is of particular concern in neighbourhoods experiencing deprivation, where stress levels may be high and coping resources are limited (Karriker-Jaffe et al., 2016). The

link between deprivation and drinking to cope may be explained by two hypotheses: 1) deprived neighbourhoods create stress due to the physical and social conditions of the neighbourhood, and alcohol is used to cope with the stress created by the environment (the stress induced pathway), or 2) those residing in these neighbourhoods have different strategies for coping with life's general stresses and are more likely to use alcohol to deal with problems (Karriker-Jaffe et al., 2016). The current study found that neighbourhood deprivation was still associated with coping motivations independent of outlet density and neighbourhood social conditions, indicating that drinking to cope is influenced by neighbourhood deprivation in ways beyond these objectively and subjectively measured characteristics of such neighbourhoods, thus lending some support to the second hypothesis. Additionally, because coping motivated drinking may represent a form of self-medication (Stapinski et al., 2016), this is an important finding which suggests the need for targeted strategies that can help individuals cope with negative affect without alcohol.

Neighbourhood disorder was associated with coping motives indirectly through perceived disorder. Moreover, perceived disorder was associated with social and enhancement motives. This is like the finding of the Portuguese study that perceptions of violence and robberies, as indictors of disorder, were associated with drinking to cope (Simões et al., 2018), highlighting that perceiving the local area as a more problematic neighbourhood gives rise to stronger drinking motives generally, except for conformity. It is difficult to explain these relationships as they may form from an unmeasured confounding variable such as a personality trait; or that observing disordered neighbourhood conditions leads to a higher motivated state to drink alcohol. Future work is needed to disentangle these observed associations.

Those in accessible small-towns also had higher coping motives than their peers living in large cities. Few studies have examined the health of adolescents residing in small towns on the periphery of larger urban areas. Research in the US examined afflu-

ent suburban adolescents compared to disadvantaged urban adolescents and found that suburban youth reported significantly higher levels of substance use than urban adolescents and that anxiety levels were also higher (Luthar and D'Avanzo, 1999). However, Scottish small-towns may differ substantially from affluent US suburban areas; these regions are seldom examined in research and more studies are needed to understand the health behaviours of adolescents in these areas. Examining the health of adolescents in small towns is an important area of future inquiry, particularly because these adolescents are often overlooked compared to their urban and rural peers.

Mediation analysis found that neighbourhood deprivation and living in an accessible small town were indirectly associated with weekly drinking through coping motivations. This supports previous research that found the effects of neighbourhood socio-economic status on substance use outcomes were likely to be indirect (Karriker-Jaffe, 2011; Zimmerman and Farrell, 2017). Additionally, neighbourhood disorder had an indirect relationship with weekly drinking through perceived disorder and coping motivations further highlighting that distal exposures are often transmitted through several links in a chain (Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016).

Drinking motives are a concept that may aid in better targeting and designing prevention and intervention programmes for at-risk adolescents (Stewart et al., 2010; Sudhinaraset et al., 2016). The current measures are based on drinking to deal with negative emotions, depression, anxiety and low mood. Ignoring the function that alcohol plays for young people could lead to unintended consequences of alcohol policy as the drinking may wane, but the underlying emotions will still be present. Simply reducing access to alcohol (with policies like taxation, minimum-unit pricing, and restrictive purchasing) for adolescents in neighbourhoods at greater risk may impact on consumption but doesn't get to the root of why adolescents are drinking more frequently in these contexts. Therefore, public health strategies that address motivations and the underlying factors that lead to coping drinking motives may be more effective at reduc-

ing geographic inequalities in adolescent health than those which focus on consumption alone.

This research has several strengths. First, it examines multiple conditions of the neighbourhood to determine which specific conditions may be associated with adolescent drinking motives. Second, the drinking motives revised short form scale is a well validated tool, and this work is the first to use these measures to examine neighbourhood characteristics and their relationship to drinking motives. Third, this is the first study, to the best of my knowledge, which tests for a potential mediation effect of drinking motives on the relationship between neighbourhood characteristics and alcohol consumption. However, there are several study limitation to consider. Although coping motivations varied by neighbourhood, the majority of variance is explained at the individual level; this is not unexpected given that drinking motives have been found to be related to intrinsic individual characteristics such as personality type (Kuntsche et al., 2014). This work did not account for personality traits; further work is needed to understand how personality might impact the relationship between neighbourhood conditions and alcohol use. However, modification of individual intrinsic factors such as personality may be more difficult than modifying or targeting the neighbourhoods young people reside. So, although the more distal, neighbourhood factors, tend to exhibit smaller effect sizes, these represent areas of potential action. Further, this study is cross-sectional, so causation cannot be inferred. Time-series analyses and evaluation studies are needed to understand the impact of changes in the local area on drinking motives and behaviours (Lin et al., 2012).

In conclusion, of the four motivations examined, only coping motives varied across neighbourhoods. Based on these findings, public health policies that develop adaptive strategies to improve alcohol-free methods for young people to help them cope better with life's stresses may be particularly effective if targeted at young people living in small towns or areas of high neighbourhood deprivation.

Chapter 10

Discussion and conclusions

10.1 Introduction

In this chapter key findings from the discussion sections of earlier chapters are compiled and the original contribution of this research is set-out. Strengths and limitations are expanded on and discussed. Implications for research and policy are emphasised. Finally, recommendations are made for future research.

10.2 Key findings

- A clear urban/rural gradient was found in adolescents reporting having ever drunk alcohol.
- For adolescents who have ever drank only certain urban rural classifications were associated with weekly drinking and drunkenness.
- Neighbourhood social cohesion was associated with having ever drunk alcohol.
- Weekly drinking was associated with neighbourhood income deprivation.
- There was little influence of neighbourhood characteristics on adolescent drinking

motives except for drinking to cope.

- Coping motivations mediated the relationship between neighbourhood deprivation and weekly drinking.
- An indirect relationship was found between neighbourhood level disorder and weekly alcohol use through individual perceptions of disorder.
- The neighbourhood social environment has received increasing research attention; however, many studies focus on individual perceptions and do not extend to the neighbourhood level.
- There was substantial heterogeneity in both the conceptualisations and the items used in studies measuring adolescent neighbourhood social environmental constructs.
- Using existing data from the HBSC Survey constructs of the neighbourhood social environment were able to be measured at the individual and neighbourhood level.
- Student's perceptions of social cohesion were higher for those residing in rural areas. Perceptions of neighbourhood disorder were lower for students residing in rural areas and highest in accessible small-towns.
- Neighbourhood level measures of social cohesion and disorder had convergent validity and acceptable reliability.

This study represents an original contribution in that:

- An oversample of rural adolescents allowed for urban/rurality to be examined on a continuum rather than dichotomously. Findings show living in accessible small-towns is associated with drunkenness, weekly drinking, having ever drank (in fully adjusted models), and drinking to cope. This association would be masked if a less detailed classification were used. The health of those in areas that are not

urban or rural are often overlooked. The findings of this study show that the health of those in these areas warrants greater attention. Not only do Scottish 15-year olds drink more in these areas but they also perceive their neighbourhood to be more disordered.

- Few studies examine neighbourhood social characteristics and adolescent drinking, beyond socio-economic conditions. This is the first study to explore these potential associations in Scotland.

- This is the first study to examine the associations between neighbourhood conditions and adolescent drinking motives. Further, this is the first evidence that motivations to cope mediate the relationship between neighbourhood conditions and adolescent alcohol use.

10.3 Strengths

This study has several strengths. Generally, studies of neighbourhood characteristics are useful for saying where efforts are needed and can aid in resource allocation; these studies are also valuable for hypothesis generation (Shankardass and Dunn, 2012) In keeping with this, this research identified that certain neighbourhood characteristics are associated with drinking behaviours. Moreover, the influence of the social environment on alcohol use was explored. This allows for hypothesis generation about the role of the social environment on adolescent alcohol use and linking of empirical evidence with theory. The hierarchical analytical strategy used in Chapter 8, also allowed for testing of whether the social environmental conditions of where adolescents live explain any relationship between neighbourhood deprivation and alcohol use as has been hypothesised previously (Bloomfield and Stock, 2013; Jackson et al., 2014). Moreover, examining whether the motivations for drinking varied by neighbourhood conditions, allowed for a better understanding of the function alcohol plays, and how targeted interventions can

be developed. This also allowed for a better comprehension of the pathways for which neighbourhood impacts adolescent alcohol use.

The boosted sample of rural adolescents was a major advantage to this research as it facilitated a more fine-grained analysis of the urban/rural conditions that adolescents live. The health and well-being of young people living in conditions 'in-between' urban and rural warrants more evaluation, as highlighted from the findings of this work. Additionally, several alcohol use outcomes were utilised in the study. The amount of variation accounted for by the neighbourhood differed by drinking outcome. This might explain some of the dissimilar findings of previous studies regarding adolescent alcohol use and neighbourhood social environmental characteristics.

This research used aggregate measures of neighbourhood perceptions to quantify neighbourhood social conditions. In the literature, individual perceptions are often used as a proxy for neighbourhood-level measures. This is problematic as individual's substance use and perceptions may both be influenced by the same confounding variables. Accounting for neighbourhood level conditions gave a better indication of the collective conditions of the neighbourhoods. Care was taken in calculating the neighbourhood environmental condition variables.

Examining neighbourhood by residential location rather than using school as a proxy for residence was another strength. In secondary schools the catchment area can be large so using school as a proxy may introduce measurement error. In this study students' residential postcodes were used to place them in neighbourhoods and the questions regarding their neighbourhood asked about the local area where students lived. Although grouping students into administrative boundaries may not reflect their perceived local area; it represents an improvement over using the area surrounding school.

This study took care when selecting an analytical strategy, and during choice of confounders to include in models, to avoid over controlling of potential mediators, which may potentially mask neighbourhood effects (Jackson et al., 2014; Jackson, Denny,

Sheridan, Fleming, Clark, Peiris-John and Ameratunga, 2016). It is noted that controlling for factors that are on the theoretical pathway between more distal measures and outcomes may lead to underestimation (Shankardass and Dunn, 2012). Factors such as peer or family support were not included as they are more proximal variables that may impact on adolescent drinking but may also be impacted on by neighbourhood conditions. Additionally, all models were conducted first without individual perceptions and then with perceptions included; this was done to better understand how inclusion of these perception in the model influenced the collective measures. Inclusion of perceptions is standard in studies examining collective social phenomena to tease out whether the relationships are at the neighbourhood or individual level; however, theoretically, the perceptions may be impacted by the collective attributes and so by examining the models with and without individual perceptions a better understanding is gained.

10.4 Limitations

Several limitations should be considered when interpreting this research. Individuals' collective perceptions were used to ascertain the collective neighbourhood social environment. There is no alternative as those within the neighbourhoods are the only ones who can evaluate this. However, each person represents an imperfect 'informant' (OCampo, 2003). Their ability to report on their neighbourhood might have been influenced by time living in the neighbourhood as well as personal characteristics. The approach taken to aggregate the neighbourhood social environment separates the variance in neighbourhood perceptions between neighbourhoods and between individuals, which may address some of this concern (OCampo, 2003). However, it is still an important consideration and if it had been available, information on time living in the local area would have been useful in improving analysis. These analytic considerations are important in terms of measurement and when looking at associations; as these characteristics could also be associated with alcohol use (same-source bias). An alternative

approach would be to measure neighbourhood conditions from a separate sample of adolescents than those being analysed in terms of alcohol outcome data. This would eliminate concerns of same-source bias. To do this small-area statistics would need to be calculated at the national level. This is no small task, but large-scale government surveys of young people may provide a means of doing this in the future.

A concern in multilevel analysis is small numbers of individuals nested within units (i.e., neighbourhoods and schools). Because this study used an aggregate measure approach a cut-off was needed, and therefore only neighbourhoods with 5 or more individuals were included in analysis in Chapters 8 and 9. This was chosen as a cut-off as it has been used in similar studies (Prins et al., 2014). However, in some neighbourhoods this reduced when the sample became smaller because of missing data on variables or when only drinkers were included. However, previous work has not found that having some neighbourhoods with low numbers was a concern and training documentation also includes examples such as this (Leckie, 2010*a*; Riva et al., 2009).

The study sample did not have much ethnic diversity. The categories of white and not white do not fully reflect cultural differences that may impact drinking behaviours. Adolescents from immigrant households or from different religious backgrounds may have different alcohol use patterns, and these individuals may cluster geographically. Additionally, in the analyses of just drinkers this may result in low power for this variable. Studies designed to capture different cultural populations in Scotland are needed to fully explore this.

There were no measures of neighbourhood social norms around alcohol (i.e., beliefs about alcohol or population level consumption) included in the analysis. This may explain some of the urban/rural differences in alcohol use that were unexplained by neighbourhood social characteristics or AOD. Future studies designed to examine this are needed to determine if this may contribute to the observed inequalities.

Only S4s were examined in this study as the boosted rural sample and drinking

motivation items were only available for this group. This meant that this research could not examine differing associations by age. This limits the generalisability of this study to all adolescents. Jackson, Denny, Sheridan, Fleming, Clark, Peiris-John and Ameratunga (2016) found differing effects by age for collective efficacy and drinking behaviours in their study of adolescents in New Zealand. Examining the relationships of neighbourhood characteristics on alcohol use on older and younger adolescents in Scotland is an important area of further inquiry.

This study was cross-sectional, so causation cannot be inferred, only association. It is theorised that neighbourhood factors impact on adolescent drinking; however, the reverse could be true. It has been noted that concerns surrounding reverse causation and neighbourhood effects are less salient in studies of adolescents because adolescents do not choose their neighbourhood (Morris et al., 2018). However, it is also possible that neighbourhood social conditions and adolescent drinking relate in a complex and dynamic way. These complexities are not represented in this study. Generally, the results of this study can be interpreted following Box and Draper (1987) in believing that 'all models are wrong, but some are useful'. The view that in social science analyses are often exploratory, is to be considered in this research. Generally, the findings support or do not support theories based on previous research done in different cultural contexts.

10.5 Research implications

10.5.1 Conceptualising and measuring neighbourhood social environments

The various concepts of the neighbourhood social environment are ill- defined in research with adolescents; this creates a barrier in comparing research and advancing the field. These concepts represent individuals' feelings and perceptions, and therefore are open to woolly interpretations. Additionally, the multidisciplinary interest of these concepts

has meant that several overlapping ideas have evolved separately. When using survey items to measure these concepts there is much intersection.

At the onset of this research it was thought that through examining the use of these measures in past research, clear distinctions would emerge to inform the research in subsequent chapters. However, the opposite occurred. When investigating the measurement items and manuscript texts, much intersection was found between concepts. Often authors would use one concept to define another; highlighting the connection between terms. This made it difficult to select a body of research to draw upon, and the terms 'social cohesion' and 'neighbourhood disorder' were chosen as labels that were suitably broad in that they encapsulate a wide research base; however, given the high levels of overlap in concepts this is rather arbitrary. This difficulty in situating research was well summarised by Galea et al. (2004):

> "In epidemiologic studies, clear definition of the potential determinants and of the disease or behavior of interest is essential. Although this may seem self-evident, in studies considering the social epidemiology of substance use, it is not infrequent that exposure and outcome are either not clearly defined or not comparable across studies" (p.48)

Galea et al. (2004) goes on to highlight that it is possible that social exposure variables "represent related, but different constructs, each meriting attention." (p.48) Given the current disparate state of measuring and conceptualising the neighbourhood social environment, it is not surprising that the evidence-base is mixed.

Future work is needed to map out these concepts. A glossary that strives to delineate the terms used to describe the neighbourhood social environment would be highly useful for researchers. Given the heightened interest in these concepts in health research, such a work would be timely. A possible approach to elucidating these concepts is a Delphi method, where experts and stakeholders from a variety of disciplines are involved, and

the goal is reaching consensus. Such an exercise would aid in grounding research that examines these constructs and their relationships with health behaviours and outcomes.

10.5.2 Associations of neighbourhood social environment with alcohol use and drinking motivations

This work adds to the evidence base as it moved beyond the urban US context for which most of studies of the social neighbourhood and adolescent alcohol use are conducted. Recently some studies have been conducted in New Zealand, but this is the first study to examine the impact of the neighbourhood social environment on adolescent alcohol use in Scotland. Largely the findings do not support that the neighbourhood social environment has much direct impact on adolescent alcohol use behaviours. This is like other research findings from the US (Fagan et al., 2015). However, one exception is that neighbourhood social cohesion was associated with whether adolescents had ever consumed alcohol. This finding supports theories regarding the positive impact of neighbourhood social connections on health behaviours. Further, from this finding, hypotheses regarding how neighbourhood social cohesion may impact on more delayed alcohol use can be developed. It may be that in more cohesive neighbourhoods alcohol use is delayed as the favourable bonds within the community create a positive affect that reduces alcohol use among the young (S4, typically < 16 years). However, for those who do drink by S4, no relationship was present with neighbourhood social cohesion and drunkenness, weekly alcohol consumption or drinking motives. Indicating that once drinking has occurred neighbourhood social cohesion has little impact on how or why adolescents drink. Examining what happens to adolescent drinking when a neighbourhood changes and becomes more or less socially cohesive is key to gaining better insight into this.

Neighbourhood disorder had an indirect influence on weekly drinking through perceived disorder and coping motivations. Moreover, any effect of neighbourhood disorder

became insignificant when accounting for individual perceptions. This indicates that neighbourhood level disorder may be a distal influence on adolescent alcohol use that operates through perceptions of the neighbourhood. In terms of disorder, the effect on adolescent alcohol use appears to be person centred rather than place centred. Changing neighbourhood environments might not be sufficient to change perceptions of disorder. Moreover, those who drink more might have a greater perception of disorder because they may frequent more disordered areas of the neighbourhood when drinking. Studies that combine GPS tracking and daily surveys with young people to examine their whereabouts, their perceptions of the place they come into contact, and their drinking behaviours offer a potential avenue to better understand these relationships.

10.5.3 Neighbourhoods are complex

Research often implicitly or explicitly views neighbourhoods as 'containers' in which multiple phenomena occur (Shankardass and Dunn, 2012). This is an overly simplistic view of the neighbourhood. Recently researchers have called for social epidemiology to 'embrace complexity' moving forward (Shankardass and Dunn, 2012; Stronks and Nicolaou, 2018). However, this is no easy task when conducting empirical work. The field of social epidemiology excels at identifying the characteristics of at-risk neighbourhoods and therefore answering the question: where are intervention efforts needed? But less attention is given to exploring why some neighbourhoods are unhealthy and how to reduce these inequalities (Shankardass and Dunn, 2012; Stronks and Nicolaou, 2018).

Conceptual theories are required to understand the mechanisms underlying inequalities; comprehension of why neighbourhoods exhibit risk factors are needed to develop interventions and prevention strategies (Shankardass and Dunn, 2012; Stronks and Nicolaou, 2018). This thesis examined the potential interaction between neighbourhood social conditions and other neighbourhood conditions and sex. Few interactions were found, indicating the relationships, or lack thereof, were consistent between boys and

girls and for adolescents experiencing different living conditions. Such analysis allows for a more complete view of these associations (Maimon and Browning, 2012). More work examining moderators and mediators of neighbourhood characteristics and alcohol use are needed. It is difficult to identify all potential factors that may moderate or mediate the relationships between neighbourhood social environments and alcohol use; further theoretical work is needed to guide research on this topic.

Neighbourhoods are nested within larger administrative and cultural contexts; which may be key to contributing to observed inequalities and limit the generalisability of studies. Moving forward, the macro- cultural context in which neighbourhoods are formed needs consideration. Cross-cultural studies may be key to better understanding these relationships.

Group processes also need to be explored (Stronks and Nicolaou, 2018), for example it may be that exchanges between individuals within a neighbourhood create social norms that encourage or discourage alcohol use. If these processes are at play, policies that influence the neighbourhood conditions will not be effective unless group dynamics are also considered (Stronks and Nicolaou, 2018). Generally, further work is needed that considers neighbourhoods as complex systems.

10.6 Public health implications

10.6.1 Targeting intervention and preventions policies

In terms of public health impact, where to focus resources is an import consideration. Drunkenness is most likely to be associated with acute harm among adolescents; however, drunkenness did not show much geographic variation. Public health policies that seek to address drunkenness may be better targeted at schools and the individual.

Delaying initiation into alcohol use may also have important public health considerations. Previous work has shown that those who initiate alcohol use at age 14 or younger

are at greater risk for experiencing alcohol use disorder within their lifetime (Petit et al., 2013). Therefore, although lifetime abstinence is not a realistic goal, delaying initiation of alcohol use may have positive public health implications. The most neighbourhood variation was found in having ever drunk alcohol by S4. Therefore, place-based prevention strategies may be useful in terms of delaying alcohol initiation; particularly in non-urban areas and perhaps by addressing neighbourhood social cohesion.

Regular alcohol use, such as weekly drinking, is not considered as high a public health priority as binge drinking or early initiation into alcohol use, as the risk of harms associated with this use pattern is not as pronounced. However, the neighbourhood conditions that associate with weekly drinking mirrored those associated with drinking to cope. Drinking to cope is of concern as it suggests adolescents are using alcohol to self-medicate and deal with life's stresses. Given the young age of the study participants, this is concerning and could lay the foundation for a difficult relationship with alcohol in the future. The findings of this research indicate that strategies to reduce alcohol use in more deprived areas and accessible small-towns should consider building alternative ways to cope with negative emotions other than substance use. This is an important finding as strategies that reduce alcohol use through reduced accessibility do not address the underlying function alcohol use plays in adolescent's lives. This could mean that reducing access to alcohol might reduce consumption, but that adolescents are left to find alternative means to cope. Without providing alternative strategies to cope with negative emotions unintended consequences may occur.

In line with recent interest in "place-based policy making"(Shankardass and Dunn, 2012), this work points to a need for targeted prevention strategies in non-urban areas and intervention approaches in more deprived areas and accessible small-towns. Neighbourhood social cohesion may be an avenue to delay adolescent uptake of alcohol. However, this begs the important question of: how is neighbourhood social cohesion established in terms of promoting adolescent health and well-being?

10.6.2 Community-action approaches

Community-action approaches in accessible small-towns, rural areas, and more deprived neighbourhoods, may prove a useful method to reducing observed inequalities. These approaches occur at several levels within the neighbourhood and are often developed with and by members of the community. However, these approaches must be sustained over time to be effective (World Health Organization, 2015). Toumbourou et al. (2007) describes this well:

> "In general, prevention programmes seem more successful when they maintain intervention activities over several years and incorporate more than one strategy. Developmental prevention programmes are unlikely to be adequate as a stand-alone policy to reduce population harm related to substance use, particularly for substances such as tobacco where the burden of harm falls late in life.[75] However, opportunities exist for communities to tailor a mixture of programmes that address the local conditions that give rise to substance-related harm, and developmental prevention schemes can be usefully coordinated with regulatory approaches and with treatment and harm reduction programmes. Developmental prevention activities can be coordinated using funding from different jurisdictions—eg, crime prevention, health promotion, mental health, education, and substance abuse prevention.[14]" (p.1395)

Community-action approaches are in line with The Christie Commission Report of 2011 which recognises that effective services must be designed with and for the community from the bottom up –not delivered top down- by working with communities to understand their needs, maximize resources, and support resilience. Some examples of community-actions approaches have proven effective. Project Northland was an approach to reducing youth alcohol consumption that took place in mostly rural,

lower-middle class Minnesota, in the United States, from 1991-1994. The intervention took place at multiple levels and involved peer participation, parental education and involvement, behavioural curricula, and a community task force (some adolescents were included in the community task force). Alcohol use was lower for those in the Project Northland communities in the final year of the study compared to reference communities. The difference was mainly attributable to those who were non-users at baseline (Perry et al., 1996). Another example is the Communities That Care (CTC) programme, which addresses adolescent substance use (and other 'delinquent' behaviours) by identifying risk and protective factors and uses data on these factors to select prevention and early intervention strategies. Collaboration within the community is an important element of the CTC approach. Community stakeholders are involved in the development and implementation of prevention-based programmes. The approach has been effective in the American setting but challenges implementing it in the UK have been found (Amato et al., 2017; Bannister and Dillane, 2005; France and Crow, 2005). A pilot project in three sites in Scotland, found inconsistent engagement from stakeholders, including young people, and difficulties in collecting and analysing the data used in the project (Bannister and Dillane, 2005).

In Scotland, initiatives to improve local areas for young people are under way. One example is the Young Placechangers programme. This programme is run by Greenspace Scotland and Youth Scotland. It seeks to remedy that young people's voices are not considered in local place-based consultations. This programme works with the wider community to include young people in planning improvements to their local area (`https://www.greenspacescotland.org.uk/Pages/Category/young-people`). Another example is Children's Neighbourhoods Scotland (`https://childrensneighbourhoodsscotland.com`), which works with young people and community members to identify the needs of a neighbourhood and the current resources in place. These programmes to do not explicitly deal with substance use. However, given the results of the current research in terms

of neighbourhood social cohesion, it would be interesting to explore any impact that these programmes may have on adolescent alcohol use. Moreover, these programmes are focused on urban areas, further work is needed to understand the neighbourhood needs of adolescents in small-towns and rural areas and how this impacts on adolescent alcohol use.

A richer understanding of what processes may lie beneath associations is key to better developed theories and moving towards appropriate interventions. Working with communities may be key to better developing appropriate interventions that consider the unique aspects of the locality. Experimental studies (both natural experiments and specific interventions) can be developed to test the efficacy of such approaches. However, results may only be applicable to specific places and time (Shankardass and Dunn, 2012).

10.6.3 Improving local environments

> "On many occasions, I would see patients who had been admitted to hospital with a problem associated with poor diet, alcohol or smoking. I would point out to them that failure to change their lifestyle would bring further serious health problems. The response was usually dismissive of such advice. "What do I care, doctor? What have I got to live for? Getting drunk is my main pleasure in life!" My clinical experience led me to conclude that just giving people struggling with chaotic lives information about the risks they were running was not the answer. They needed a reason to stay healthy if they were to take the decisions necessary to be healthy. In effect, they needed adequate supportive environments and coherent policies to acquire resilience to overcome the difficulties they encountered in daily life." Professor Sir Harry Burns University of Strathclyde, Former Chief Medical Officer for Scotland (Ziglio, 2018, p.8)

The findings that neighbourhood social cohesion was associated with adolescent alcohol initiation and that neighbourhood disorder had an indirect relationship with weekly drinking suggests that a potential strategy to reducing adolescent alcohol use could be to improve the local environment in which young people live. This needs to be investigated further by exploring the impact of initiatives (described above) on adolescent drinking. Although, the results cannot be interpreted as causal, improving the local environment by attempting to increase neighbourhood social cohesion and decreasing neighbourhood disorder is unlikely to introduce negative unintended consequences. Improving neighbourhood social conditions may be thought of as an end in itself, and so could be a suitable usage of public health resources. However, further research is needed to develop and evaluate initiatives to improve neighbourhood social cohesion.

The relationship of neighbourhood conditions with coping motivations needs to be interrogated further. Is it enough to remove some of the environmental stress or is it better to build capacity to cope within targeted neighbourhoods? If removing neighbourhood stress is sufficient than the answer may lie in programmes that improve neighbourhood conditions. However, if not, strategies are needed to equip young people with alternative means of coping with stress.

10.6.4 Policy recommendations

In Scotland, much policy attention is given to reducing health inequalities and to improving the health and well-being of children and adolescents. These priorities intersect with alcohol use as evident in the Scottish Governments 2018 Alcohol Framework which states that two consistent threads will run through all alcohol policy actions: 1) reduce health inequalities, and 2) protect children and young people (The Scottish Government, 2018). Considering the recently released Scottish Alcohol Framework 2018, several policy recommendations are made.

1) Continue to support access to positive alternative activities to alcohol use.

The Framework highlights the importance of 'the three prevention A's': affordability, availability and attractiveness. There is a large evidence base supporting these prevention strategies in alcohol policy, but the findings from this thesis point towards a need to go further and develop community-based strategies and understand why adolescents are drinking. The Framework states the Government will "continued work to equip our young people to make better decisions through improved substance use education and access to positive alternative activities" (p.11) and the research presented in this thesis supports the importance of these actions.

2) Implement programmes in more deprived areas the build skills to cope with life's stresses.

It is clear from the findings outlined in Chapters 8 and 9 that health inequalities are present in adolescent drinking in Scotland. In terms of a social gradient, adolescents in the least deprived areas had reduced odds of weekly drinking and higher mean levels of coping motives to drink. Public health intervention strategies that build coping resources for young people could reduce this inequality. Programmes that increase abilities to cope with daily life stress have proven successful when implemented by school psychologists and teachers (Cunningham et al., 2002). Targeting these programmes to young people living in more deprived neighbourhoods could improve the general health and well-being of adolescents and reduce inequalities in regular drinking. However, such programmes must be carefully developed and evaluated to ensure their efficacy for the target population.

3) Work with local areas to create cohesive communities.

Neighbourhood-level social cohesion was protective against having ever drank by S4. Although, the data utilised in this thesis were cross-sectional, so causality cannot be inferred, this finding supports the importance of efforts to improve social cohesion among young people. The Alcohol Framework points to the need to create safer communities; the findings in this thesis also highlight the importance of creat-

ing more cohesive neighbourhoods. The Scottish Governments Place Standard Tool (`https://www.placestandard.scot/`) is an instrument designed facilitate discussion around the strengths and needs of a neighbourhood and could be used to assess the level of cohesiveness that a neighbourhood is experiencing and plan for the future of the area. Tools such as this may be utilised within the scope of alcohol policy given the finding that the social cohesion of a neighbourhood is associated with adolescent alcohol use.

4) Included an aim to reduce urban/rural inequalities in future policy frameworks.

There is an urban/rural gradient in having ever drank alcohol by S4 and among those who had drank, adolescents in accessible small towns had higher odds of both weekly drinking and drunkenness. This supports the need for targeted intervention and prevention programs. Understanding the experiences of young people in these areas and incorporating their views in intervention development could provide important information on addressing these inequalities. An urban/rural action is not present in the current Alcohol Framework but given the focus on reducing inequalities, future strategies should aim to reduce alcohol use among adolescents residing in non-urban areas. Particular attention should be paid to accessible small-towns as high-risk areas. The Place Standard Tool might be particularly useful in accessible small-towns as, as found in Chapter 7, perceived disorder is higher in such regions. Implementing community-based approaches, discussed in section 10.6.3, may prove to be a useful strategy in reducing urban/rural inequalities in adolescent alcohol use.

10.7 Future research

The current study highlights the need for more research into the relationship between neighbourhood conditions and adolescent alcohol use. Moving forward, a better understanding of the neighbourhood social environment in which adolescents live is needed. Future work needs to be comparable; to get to this point a better framework for concep-

tualising the neighbourhood social environment is needed. Studies that examine whether measures of the neighbourhood social environment are invariant cross-culturally are also important.

Because this study used cross-sectional data it is not possible to determine the temporal order of the relationships. Longitudinal studies are necessary to determine if exposure to certain neighbourhood conditions impact the drinking behaviour of young people after exposure. Additionally, longitudinal studies would be useful to understand the drinking behaviours of young people who move into different neighbourhood conditions. Repeated cross-sectional studies that explore the impact of changing neighbourhood conditions on adolescent alcohol use would also add to the evidence base.

Recently studies have observed neighbourhood exposure through activity spaces using GPS technologies. These measures use the geographic space adolescents occupy rather than administrative boundaries to determine neighbourhood exposure, which represents a more realistic depiction of neighbourhood (Kwan, 2018). Additionally, mobile survey methods used in conjunction with GPS (ecological momentary assessment) could be used to collect data to quantify the neighbourhood social environmental conditions from the perspective of young people. Such work has been conducted with adolescents in urban California (Byrnes et al., 2017) and should be replicated in other contexts, such as Scotland.

This study found that urban/rurality is associated with adolescent alcohol use and that the relationship cannot be explained by commercial availability, deprivation, or social conditions. Qualitative studies would be valuable in gaining a better understanding of these differences; particularly, accessible small-towns are of interest given the findings of this thesis. These areas are often overlooked in research, thus qualitative work could add new insights to the lives of adolescents living in these areas.

10.8 Personal future research directions

From my PhD I have developed several research interests that I would like to expand on in my future work. These fall into two key themes:

Neighbourhoods and adolescent health I plan to expand my research into adolescent health outcomes and neighbourhood exposures into new realms beyond the social environment and alcohol use. For instance, I am interested in how the natural and built environments influence adolescent physical activity and mental health. I enjoy linking existing data sources to answer new research questions. I hope to continue working with the Health Behaviour in School-aged Children Study in the future.

I would also like to use other methods, such as GPS, to measure the activity spaces of adolescents to get a more realist view of their neighbourhood exposures. Additionally, moving forward I would like to continue to explore how the neighbourhood social environment is experienced by adolescents and how to incorporate these experiences into research on health behaviours.

Adolescent substance use My research has been strongly influenced by the amazing researchers I have met in the field of substance use. Currently, there are many theories regarding the decline in adolescent alcohol use, but none are particularly salient. I would like to continue exploring the patterns and trends in adolescent alcohol and other drug use in my future research.

If we are to achieve the goal of increased health and well-being of young people, there is still a need to better understand the role of alcohol and other drugs in young people's lives, as well as the risk and protective factors at play. One potential avenue is to explore the motivations for abstaining from alcohol use among those who choose not to drink. This is particularly salient in light of the dramatic cultural shifts in alcohol use observed over the past several decades.

10.9 Conclusion

This research found that for Scottish adolescents, where one lives influences their alcohol consumptions and motivations for drinking. Neighbourhood social cohesion, urban/rural status and neighbourhood deprivation may give rise to inequalities in alcohol use. Evidence of drinking to cope as a mediator in the relationship of deprivation and living in a small-town with weekly alcohol use suggests that drinking as a coping strategy differs by neighbourhood conditions. These findings support that targeted prevention and intervention strategies are needed to reduce inequalities. Programmes developed to encourage alcohol alternative coping skills should be implemented in deprived neighbourhoods and accessible small-towns. Future research is needed to develop and assess strategies to reduce inequalities in adolescent drinking in Scotland.

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Appendices

Appendix A

Systematic review protocol

Systematic review

Please complete all mandatory fields below (marked with an asterisk *) and as many of the non-mandatory fields as you can then click *Submit* to submit your registration. You don't need to complete everything in one go, this record will appear in your *My PROSPERO* section of the web site and you can continue to edit it until you are ready to submit. Click *Show help* below or click on the icon
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1. * Review title.

Give the working title of the review, for example the one used for obtaining funding. Ideally the title should state succinctly the interventions or exposures being reviewed and the associated health or social problems. Where appropriate, the title should use the PI(E)COS structure to contain information on the Participants, Intervention (or Exposure) and Comparison groups, the Outcomes to be measured and Study designs to be included.

Conceptualizing, measuring and evaluating constructs of the adolescent neighbourhood social environment: a systematic review

36 words remaining

2. Original language title.

For reviews in languages other than English, this field should be used to enter the title in the language of the review. This will be displayed together with the English language title.

50 words remaining

3. * Anticipated or actual start date.

Give the date when the systematic review commenced, or is expected to commence.

18/08/2014

4. * Anticipated completion date.

Give the date by which the review is expected to be completed.

02/02/2016

5. * Stage of review at time of this submission.

Indicate the stage of progress of the review by ticking the relevant Started and Completed boxes. Additional information may be added in the free text box provided.
Please note: Reviews that have progressed beyond the point of completing data extraction at the time of initial registration are not eligible for inclusion in PROSPERO. Should evidence of incorrect status and/or completion date being supplied at the time of submission come to light, the content of the PROSPERO record will be removed leaving only the title and named contact details and a statement that inaccuracies in the stage of the review date had been identified.
This field should be updated when any amendments are made to a published record and on completion and publication of the review.

The review has not yet started: No

Review stage	Started	Completed
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	Yes
Data extraction	Yes	Yes
Risk of bias (quality) assessment	Yes	Yes
Data analysis	Yes	Yes

Provide any other relevant information about the stage of the review here (e.g. Funded proposal, protocol not yet finalised).

6. * Named contact.

The named contact acts as the guarantor for the accuracy of the information presented in the register record.

Ms Martin

Email salutation (e.g. "Dr Smith" or "Joanne") for correspondence:

7. * Named contact email.

Give the electronic mail address of the named contact.

gm205@st-andrews.ac.uk

8. Named contact address

Give the full postal address for the named contact.

CAHRU
(Child and Adolescent Health Research Unit)
University of St Andrews
Medical and Biological Sciences Building
North Haugh
ST ANDREWS
Fife KY16 9TF

9. Named contact phone number.

Give the telephone number for the named contact, including international dialling code.

+44 (0)7917806966

10. * Organisational affiliation of the review.

Full title of the organisational affiliations for this review and website address if available. This field may be completed as 'None' if the review is not affiliated to any organisation.

Child and Adolescent Health Research Unit, School of Medicine, University of St Andrews

Organisation web address:

cahru.org

11. Review team members and their organisational affiliations.

Give the title, first name, last name and the organisational affiliations of each member of the review team. Affiliation refers to groups or organisations to which review team members belong.

Ms Gina Martin. Child and Adolescent Health Research Unit, School of Medicine, University of St Andrews
Dr Anna Gavine. Centre for Evidence Synthesis, University of Dundee
Professor Candace Currie. Child and Adolescent Health Research Unit, School of Medicine, University of St Andrews
Dr Jo Inchley. Child and Adolescent Health Research Unit, School of Medicine, University of St Andrews
Ms Martine Miller. Centre for Population Health Sciences, University of Edinburgh

12. * Funding sources/sponsors.

Give details of the individuals, organizations, groups or other legal entities who take responsibility for initiating, managing, sponsoring and/or financing the review. Include any unique identification numbers assigned to the review by the individuals or bodies listed.

This review is conducted as part of Gina Martin's PhD studies which are supported by a studentship provided by the University of St Andrews.

13. * Conflicts of interest.

List any conditions that could lead to actual or perceived undue influence on judgements concerning the main topic investigated in the review.

None

14. Collaborators.

Give the name and affiliation of any individuals or organisations who are working on the review but who are not listed as review team members.

15. * Review question.

State the question(s) to be addressed by the review, clearly and precisely. Review questions may be specific or broad. It may be appropriate to break very broad questions down into a series of related more specific questions. Questions may be framed or refined using PI(E)COS where relevant.

1) To identify studies that measure the neighbourhood social environments that adolescents inhabit.
2) To assess the methodological quality of measures of the neighbourhood social environment used in these studies.
3) To critically review how these measures are conceptualised and operationalised.
4) To make recommendations for future use of neighbourhood social environment measures for use in studies of adolescents.

194 words remaining

16. * Searches.

Give details of the sources to be searched, search dates (from and to), and any restrictions (e.g. language or publication period). The full search strategy is not required, but may be supplied as a link or attachment.

The search will be carried out using the six online databases: MEDLINE (via EBSCO), Scopus, Applied Social Science Index and Abstracts (ASSIA) which includes the Institute of Educational Sciences (ERIC) database, Cumulative Index to Nursing and Allied Health Literature (CINAHL) (via EBSCO), Web of Science, and PsycINFO (via EBSCO). Reference lists will also be searched. Citation tracking of studies meeting all criteria will also be used to identify any future studies conducted after the search dates that are relevant to the research questions. Studies are limited to those written in English and publications between 2001 and 2014.

203 words remaining

17. URL to search strategy.

Give a link to the search strategy or an example of a search strategy for a specific database if available (including the keywords that will be used in the search strategies).

Alternatively, upload your search strategy to CRD in pdf format. Please note that by doing so you are consenting to the file being made publicly accessible.

Yes I give permission for this file to be made publicly available

18. * Condition or domain being studied.

Give a short description of the disease, condition or healthcare domain being studied. This could include health and wellbeing outcomes.

Much work in the late 1990s and early 2000s highlighted the emerging field of the neighbourhood social environment in public health research. These works described the role of neighbourhood social processes on individual health and well-being outcomes and highlighted the need for better understandings of how we conceptualise and measure the social environment (i.e., Yen and Syme, 1999; Morrow, 1999, 2001; Earls and Carlson, 2001). Overall, the neighbourhood social environment is defined as the social dimensions of the neighbourhoods in which we live (Yen & Syme, 1999). However, the complex social systems that make up the social environment suffer from ambiguity of definitions that creates difficulties in measurement (Earls & Carlson, 2001).

Among adolescents choice and freedom to engage in behaviours is influenced, at least in part, by the neighbourhood social environments to which they are exposed (Morrow, 1999, 2001). Adolescents are active agents within their neighbourhoods; however, their agencies within the wider social and physical environments are widely overlooked in studies that utilize adult-centred measures (Morrow, 1999; Paiva et al., 2014).

Accordingly this review will include all quantitative measures that are designed specifically to measure the neighbourhood social environment, such as, neighbourhood social capital, neighbourhood disorganization and neighbourhood disorder.

Earls, Felton, & Carlson, Mary. (2001). The social ecology of child health and well-being. Annual review of public health, 22(1), 143-166.

Morrow, Virginia. (1999). Conceptualising social capital in relation to the well-being of children and young people: a critical review. The sociological review, 47(4), 744-765.

Morrow, Virginia. (2001). Young people's explanations and experiences of social exclusion: retrieving Bourdieu's concept of social capital. International Journal of Sociology and Social Policy, 21(4/5/6), 37-63.

Paiva, Paula Cristina Pelli, de Paiva, Haroldo Neves, de Oliveira Filho, Paulo Messias, Lamounier, Joel Alves, e Ferreira, Efigênia Ferreira, Ferreira, Raquel Conceição, . . . Zarzar, Patrícia Maria. (2014). Development and Validation of a Social Capital Questionnaire for Adolescent Students (SCQ-AS). PloS one, 9(8), e103785.

Yen, Irene H, & Syme, S Leonard. (1999). The social environment and health: a discussion of the epidemiologic literature. Annual review of public health, 20(1), 287-308.

142 words over

19. * Participants/population.

Give summary criteria for the participants or populations being studied by the review. The preferred format includes details of both inclusion and exclusion criteria.

The study population is adolescents (age 10-19 years/grades 5-12, or equivalent).

189 words remaining

20. * Intervention(s), exposure(s).

Give full and clear descriptions or definitions of the nature of the interventions or the exposures to be reviewed.

Studies will be included if they report on quantitative studies published in a scholarly journal and report the use, original development, or refinement, of tools that have been developed to measure the social environment of adolescents. In order to ensure that the neighbourhood social environment is the foci of the study, only geographically bound indicators will be included, meaning measured as perceptions of the local areas in which adolescents spend their time (i.e., the question specifically referred to 'local area', 'neighbourhood', 'community', etc.). Additionally, inclusion will be limited to studies where the social environment is assessed by adolescent observations or perceptions; thus excluding adult perceptions or administrative measures. This is in-line with Schaefer-McDaniel's (2004) arguments that adults cannot fully represent with accuracy the experience and perceptions of young people in their environment. The population was limited to adolescents (age 10-19 years/ grades 5-12, or equivalent). Studies that included

adolescence with younger children or young adults will be excluded unless findings are reported separately for adolescents within the age criteria. Studies where the population under study is college/university students will also be excluded as this represents a distinct population. Furthermore, studies are limited to those written in English and publications between 2001 and 2014.
Studies examining social conditions at the school or family level will not be included. Additionally, studies where neighbourhood socio-economic status is the only predictor of the social environment will be excluded. This is to allow for a more focused review into the social environment beyond neighbourhood deprivation (Sampson et al., 2002). Other measures that will not be included are general quality of life indicators that include some items of the neighbourhood within a larger quality of life framework, measures that are solely of the physical environment, and single item measures of the social environment. Moreover, studies which only focused on community violence will not be included as a previous study has examined the measurement of community violence in studies of adolescents (see Brandt et al. 2005).
Finally, studies that do not provide full details of items used in the research or provide a citation of where these items will be found will not be included due to dearth of detail preventing a meaningful assessment of methodological quality.
Brandt, René, et al. "Epidemiological measurement of children's and adolescents' exposure to community violence: Working with the current state of the science." Clinical child and family psychology review 8.4 (2005): 327-342.
Sampson, Robert J, Morenoff, Jeffrey D, & Gannon-Rowley, Thomas. (2002). Assessing" neighborhood effects": Social processes and new directions in research. Annual review of sociology, 443-478.
Schaefer-McDaniel, Nicole J. (2004). Conceptualizing social capital among young people: Towards a new theory. Children Youth and Environments, 14(1), 153-172.
244 words over

21. * Comparator(s)/control.

Where relevant, give details of the alternatives against which the main subject/topic of the review will be compared (e.g. another intervention or a non-exposed control group). The preferred format includes details of both inclusion and exclusion criteria.

Not applicable
198 words remaining

22. * Types of study to be included.

Give details of the types of study (study designs) eligible for inclusion in the review. If there are no restrictions on the types of study design eligible for inclusion, or certain study types are excluded, this should be stated. The preferred format includes details of both inclusion and exclusion criteria.

As previously stated, quantitative studies published in a scholarly journal and reporting the use, original development, or refinement, of tools that have been developed to measure the social environment of adolescents will be included.
116 words remaining

23. Context.

Give summary details of the setting and other relevant characteristics which help define the inclusion or exclusion criteria.
250 words remaining

24. * Main outcome(s).

Give the pre-specified main (most important) outcomes of the review, including details of how the outcome is defined and measured and when these measurement are made, if these are part of the review inclusion criteria.

Neighbourhood social environment
197 words remaining

Timing and effect measures
200 words remaining

25. * Additional outcome(s).

List the pre-specified additional outcomes of the review, with a similar level of detail to that required for main outcomes. Where there are no additional outcomes please state ‘None’ or ‘Not applicable’ as appropriate to the review

None
299 words remaining

Timing and effect measures
300 words remaining

26. Data extraction (selection and coding).

Give the procedure for selecting studies for the review and extracting data, including the number of researchers involved and how discrepancies will be resolved. List the data to be extracted.

Database searches will yield titles and abstracts for screening. One researcher will screen all titles and abstracts, and a second researcher will independently screen a sample of 15% of the abstracts in order to establish inter-rater agreement. Disagreements will be resolved by discussion and consensus and where consensus cannot be reached discussion will occur with a third researcher.

Evaluation of the methodological quality of psychometric measures will be assessed using the 4-Point COnensus-based Standards from the selection of health status Measurement INstruments (COSMIN) checklist (Mokkink et al., 2010; Terwee et al., 2012). This module based standardised instrument was designed to evaluate the methodological quality of measures from health status questionnaires based on reliability and validity (Paalman, Terwee, Jansma, & Jansen, 2013). It has been shown to be a useful tool in past systematic reviews (Paalman et al., 2013). Similar to past studies using the CoSMIN checklist we will use a subset of the available modules to assess the reliability and validity of measurement instruments as many of the modules were not applicable in most studies (Ammann-Reiffer et al., 2014). Reliability and validity were assessed using questions from “Box A-Internal Consistency” and “Box E -Structural Validity” (duplicate or overlapping questions will only be assessed once). It will also be noted when aggregate (neighbourhood level) measures were derived and, in the absence of a quality appraisal tool for aggregate measures, any attempts made to describe the reliability or validity will be noted. Where data are duplicated in multiple studies for the same population a note will be made and all studies will be included in the narrative synthesis but the measure will only be evaluated once. Additionally, data will be extracted on the study characteristics of: geographic region, urban/rurality, participants’ age, sample size, number and size of neighbourhoods and, if relevant, the outcome variable(s) examined.

Ammann-Reiffer, C., Bastiaenen, C. H., de Bie, R. A., & van Hedel, H. J. (2014). Measurement properties of gait-related outcomes in youth with neuromuscular diagnoses: a systematic review. Physical therapy.

Mokkink, Lidwine B, Terwee, Caroline B, Patrick, Donald L, Alonso, Jordi, Stratford, Paul W, Knol, Dirk L, . . . de Vet, Henrica CW. (2010). The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. Quality of Life Research, 19(4), 539-549.

Paalman, Carmen H, Terwee, Caroline B, Jansma, Elise P, & Jansen, Lucres MC. (2013). Instruments Measuring Externalizing Mental Health Problems in Immigrant Ethnic Minority Youths: A Systematic Review of Measurement Properties. PloS one, 8(5), e63109.

Terwee, Caroline B, Mokkink, Lidwine B, Knol, Dirk L, Ostelo, Raymond WJG, Bouter, Lex M, & de Vet, Henrica CW. (2012). Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. Quality of Life Research, 21(4), 651-657.

165 words over

27. * Risk of bias (quality) assessment.

State whether and how risk of bias will be assessed (including the number of researchers involved and how discrepancies will be resolved), how the quality of individual studies will be assessed, and whether and how this will influence the planned synthesis.

One researcher will extract the data and a second researcher will independently review all data extracted by the first reviewer. Disagreements will be resolved through discussion and where necessary a third researcher will be consulted.

165 words remaining

28. * Strategy for data synthesis.

Give the planned general approach to synthesis, e.g. whether aggregate or individual participant data will be used and whether a quantitative or narrative (descriptive) synthesis is planned. It is acceptable to state that a quantitative synthesis will be used if the included studies are sufficiently homogenous.

A narrative synthesis will be used in order to discuss the conceptualisation and operationalization of the adolescent neighbourhood social environment taking the methodological quality of the instruments into

account. Comparable characteristics of measurement instruments will be highlighted.
In order to ensure that the measurement instruments are of sufficient quality to draw appropriate conclusions it was decided ad hoc, due to large number of poor quality measurements, that those studies where the instrument was deemed poor quality will not be included in the narrative synthesis.
217 words remaining

29. * Analysis of subgroups or subsets.

Give details of any plans for the separate presentation, exploration or analysis of different types of participants (e.g. by age, disease status, ethnicity, socioeconomic status, presence or absence or co-morbidities); different types of intervention (e.g. drug dose, presence or absence of particular components of intervention); different settings (e.g. country, acute or primary care sector, professional or family care); or different types of study (e.g. randomised or non-randomised).

None planned
248 words remaining

30. * Type and method of review.

Select the type of review and the review method from the lists below. Select the health area(s) of interest for your review.

Type of review

Cost effectiveness
No

Diagnostic
No

Epidemiologic
No

Individual patient data (IPD) meta-analysis
No

Intervention
No

Meta-analysis
No

Methodology
No

Narrative synthesis
No

Network meta-analysis
No

Pre-clinical
No

Prevention
Yes

Prognostic
No

Prospective meta-analysis (PMA)
No

Review of reviews
No

Service delivery
No

Synthesis of qualitative studies
No

Systematic review
Yes

Other
No

Health area of the review

Alcohol/substance misuse/abuse
No

Blood and immune system
No

Cancer
No

Cardiovascular
No

Care of the elderly
No

Child health
No

Complementary therapies
No

Crime and justice
No

Dental
No

Digestive system
No

Ear, nose and throat
No

Education
No

Endocrine and metabolic disorders
No

Eye disorders
No

General interest
No

Genetics
No

Health inequalities/health equity
No

Infections and infestations
No

International development
No

Mental health and behavioural conditions
No

Musculoskeletal
No

Neurological
No

Nursing
No

Obstetrics and gynaecology
No

Oral health
No

Palliative care
No

Perioperative care
No

Physiotherapy
No

Pregnancy and childbirth
No

Public health (including social determinants of health)
No

Rehabilitation
No

Respiratory disorders
No

Service delivery
No

Skin disorders
No

Social care
No

Surgery
No

Tropical Medicine
No

Urological
No

Wounds, injuries and accidents
No

Violence and abuse
No

31. Language.

Select each language individually to add it to the list below, use the bin icon to remove any added in error.
English

There is an English language summary.

32. Country.

Select the country in which the review is being carried out from the drop down list. For multi-national collaborations select all the countries involved.

Scotland

33. Other registration details.

Give the name of any organisation where the systematic review title or protocol is registered (such as with The Campbell Collaboration, or The Joanna Briggs Institute) together with any unique identification number assigned. (N.B. Registration details for Cochrane protocols will be automatically entered). If extracted data

will be stored and made available through a repository such as the Systematic Review Data Repository (SRDR), details and a link should be included here. If none, leave blank.

50 words remaining

34. Reference and/or URL for published protocol.

Give the citation and link for the published protocol, if there is one

Give the link to the published protocol.

Alternatively, upload your published protocol to CRD in pdf format. Please note that by doing so you are consenting to the file being made publicly accessible.

Yes I give permission for this file to be made publicly available

Please note that the information required in the PROSPERO registration form must be completed in full even if access to a protocol is given.

35. Dissemination plans.

Give brief details of plans for communicating essential messages from the review to the appropriate audiences.

This review will be disseminated through conferences, meetings and publication.

Do you intend to publish the review on completion?

Yes

36. Keywords.

Give words or phrases that best describe the review. Separate keywords with a semicolon or new line. Keywords will help users find the review in the Register (the words do not appear in the public record but are included in searches). Be as specific and precise as possible. Avoid acronyms and abbreviations unless these are in wide use.

Neighbourhood social environment
Adolescence
Community
Measurement
Constructs

37. Details of any existing review of the same topic by the same authors.

Give details of earlier versions of the systematic review if an update of an existing review is being registered, including full bibliographic reference if possible.

50 words remaining

38. * Current review status.

Review status should be updated when the review is completed and when it is published.

Please provide anticipated publication date

Review_Completed_published

39. Any additional information.

Provide any other information the review team feel is relevant to the registration of the review.

40. Details of final report/publication(s).

This field should be left empty until details of the completed review are available.

Martin G, Gavine A, Inchley J, Currie C. Conceptualizing, measuring and evaluating constructs of the

adolescent neighbourhood social environment: A systematic review. SSM-Population Health. 2017 Mar 11.

Give the link to the published review.

http://www.sciencedirect.com/science/article/pii/S2352827316301343

Appendix B

Systematic review search strategy

Table B.1: Search term strategy used in Web of Science, Medline, ASSIA, CINAHL and PsycInfo.

	Collective Terms	**Search Terms**
1	Components of the social environment	"social environment*" OR "social capital" OR "social disorganisation" OR "social disorganization" OR "social disorder" OR "social cohesion" OR "social trust" OR "social control" OR "informal control" OR "social ecology" OR socioecolog* OR "collective efficacy" OR "sense of community" OR "sense of place" OR "distal factor*" OR "distal character*" OR "place character*"OR "place attachment*" OR "communities that care" OR "neighbourhood disorganisation" OR "neighbourhood disorganization" OR "neighbourhood disorder" OR "neighbourhood cohesion" OR "neighbourhood trust" OR "neighbourhood control" OR "neighbourhood problem*" OR "neighbourhood safety" OR "neighbourhood stress" OR "neighbourhood organisation" OR "neighbourhood organization" OR "neighbourhood attachment" OR "neighbourhood perception*" OR "neighbourhood qualit*" OR "neighbourhood support*" OR "neighbourhood character*" OR "neighbourhood factor*" OR "neighbourhood strength*" OR "neighbourhood satisfaction" OR "neighborhood disorganisation" OR "neighborhood disorganization" OR "neighborhood disorder" OR "neighborhood cohesion" OR "neighborhood trust" OR "neighborhood control" OR "neighborhood problem*" OR "neighborhood safety" OR "neighborhood stress" OR "neighborhood organisation" OR "neighborhood organization" OR "neighborhood attachment" OR "neighborhood perception*" OR "neighborhood qualit*" OR "neighborhood support*" OR "neighborhood character*" OR "neighborhood factor*" OR "neighborhood strength*"OR "neighborhood satisfaction" OR "community disorganisation" OR "community disorganization" OR "community disorder" OR "community cohesion" OR "community trust" OR "community control" OR "community problem*" OR "community safety" OR "community stress" OR "community organisation" OR "community organization" OR "community attachment" OR "community perception*" OR "community qualit*" OR "community support*" OR "community character*" OR "community factor*" OR "community strength*" OR "community satisfaction"
2	Population	adolescen* OR teen* OR youth OR "young people" OR "schoolchildren*" OR "school children" OR "school age*"

Appendix C

Systematic review item coding

Table C.1: Item codes used in systematic review.

Item themes	**Questions (study)**
Positive Interpersonal connections	Adults in my neighbourhood make me feel important (1)
	Adults in my neighbourhood listen to what I have to say (1)
	In my neighbourhood I feel like I matter to people (1)
	People in this neighbourhood look out for each other (6)
	You know most of the people in your neighbourhood (6)
	In the past month, you have stopped on the street to talk with someone who lives in your neighbourhood(6)
	People say "hello" and talk to each other in the streets (8)
	You can trust people around here (8)
	I could ask for help or favour from a neighbour (8)
	I know many people in my neighbourhood by name (10)
	People in my neighbourhood encourage me to do my best (10)
	People in my neighbourhood care about how things are going in my life (10)
	I spend a lot of time with kids where I live (11)
	I get along with kids in my neighbourhood (11)
	I hang out a lot with kids in my neighbourhood (11)
	Everybody is willing to help each other in my neighbourhood (12)
	People are there for each other in my neighbourhood (12)
	People support each other in my neighbourhood (12)
	People in my neighbourhood work together to get things done (12)
	We look out for each other in my neighbourhood (12)
	If I needed help I could go to anyone in my neighbourhood (12)

Item themes	Questions (study)
	People in my neighbourhood pitch in to help each other (12)
	I feel okay asking for help from my neighbours (12)
	My neighbours get along well with each other (13)
	Adults in my community care about people my age (13)
	Adults in my neighbourhood or community help me when I need help (13)
	Adults in my neighbourhood or community let me know they are proud of me (13)
	Adults in my neighbourhood or community spend time talking with me (13)
	People in the neighbourhood could be trusted (14)
	People in the neighbourhood care a lot about each other (14)
	People in the neighbourhood are willing to help each other (14)
	People in your neighbourhood often help each other out (15)
	People in your neighbourhood often visit each other's homes (15)
	If I need advice about something I could go to someone in my neighbourhood (16)
	There are adults in my neighbourhood that I look up to (16)
	If I got in trouble I know someone who would help me out in my neighbourhood (16)
	I know the names of a lot of people in my neighbourhood (16)
	I know someone I could borrow money from (for bus fare or something else) (16)
	I regularly stop to talk with people in my neighbourhood (16)
	I visit with neighbours in their homes (16)
	I live in a close knit community (17)
	People (around) here are willing to help their neighbours (17)

Item themes	Questions (study)
	People in my community generally get along with each other (17)
	The adults in my neighbourhood are concerned with the well-being of the youth (19)
	People my age can find adults in my neighbourhood to help solve problems (19)
	The adults in my neighbourhood say that young people must be heard (19)
	In my neighbourhood, when adults make decisions that affect young people, they listen to youth's opinions (19)
	Adults in my neighbourhood value the youth (19)
	People my age feel valued by adults in the neighbourhood (19)
	There are a lot of adults I can talk to (21)
	Our neighbours listen to what kids have to say (21)
	People in my neighbourhood are proud of me (21)
	My neighbours notice when I do a good job (21)
	People in my town collaborate together (22,23)
	People in this place support others (22, 23)
	People in my town work together to improve things (22, 23)
	Many people in this town are willing to help each other (22, 23)
	In this place I feel like I can share experiences and interests with other young people (22,23)
	In my town people look out for each other and get along well (22)
	People in my town are willing to share things (22)
	I spend a lot of time with other adolescents that live in this place(22,23)
	Many of my real friends are young people that live in this town(22)
	I like to stay with other adolescents who live in this town (22,23)

Item themes	Questions (study)
	In this place, there are people able to stay beside me if I need it (22)
	If I need a little help, I can ask for it to someone who lives in my town (22)
	If I feel like talking I can generally find someone in my town to chat to (22,23)
	There are people here that represent an important source of moral support to me (22)
	In this place, it is not difficult to find someone that can give some advice if I need to make a decision (22)
	The friendships and connections I have with people in my neighbourhood mean a lot to me (24)
	I feel loyal to the people in my neighbourhood (24)
	Most of my friends live in this neighbourhood (24)
	Adults in my neighbourhood are interested in what young people in the neighbourhood are doing (25)
	If I had problems there are neighbours who could help me (25)
	People in my neighbourhood really help each other out (25)
	Adults in my neighbourhood encourage young people to get an education (25)
	Young people in my neighbourhood show respect to adults (25)
	Adults in my neighbourhood seem to like young people (25)
	Adults in my neighbourhood can be trusted (25)
	Many of the people in this town are available to provide help when someone needs (30)
	The people in this town are polite and well mannered (30)
	If I had a problem there are neighbours I could count on to help me (32)

Item themes	**Questions (study)**
	Most people in my community know and care for each other (32)
	My neighbours notice when I do a good job and let me know about it (27)
	There are a lot of adults I can talk to about something important (27)
	There are people in my neighbourhood who encourage me to do my best (27)
	There are people in my neighbourhood who are proud of me when I do something well (27)
Deviant behaviours	Teenagers in my neighbourhood are out of control (4)
	How often are there problems with muggings , burglaries, assaults or anything like that in your neighbourhood (9)
	How much of a problem is the selling and using of drugs in your neighbourhood (9)
	There is a lot of crime in your neighbourhood (15)
	A lot of drug selling goes on in your neighbourhood (15)
	There are lots of street fights in your neighbourhood (15)
	In my neighbourhood there are people who sell drugs (19)
	People in my neighbourhood commit crimes and hooliganisms (19)
	In my neighbourhood there are often fights between street gangs (19)
	Alcoholics and excessive drinking in public in the neighbourhood (20)
	What describes your neighbourhood: fights and brawls (21)
	What describes your neighbourhood: crime, drug selling (21)
	How likely are young people in the neighbourhood to get in trouble with police? (25)
	How likely are young people in the neighbourhood to use drugs? (25)
	How likely are young people in the neighbourhood to join a gang? (25)

Item themes	Questions (study)
	How likely are young people in the neighbourhood to drink an alcoholic beverage? (25)
	How likely are young people in the neighbourhood to carry a weapon such as a gun, knife or club? (25)
	Have any of the following happened in your neighbourhood over the past 30 days someone you lived with was robbed or mugged? (25)
	Have any of the following happened in your neighbourhood over the past 30 days someone in your neighbourhood was robbed or mugged? (25)
	Have any of the following happened in your neighbourhood over the past 30 days someone broke into your home or your neighbour's home? (25)
	Have any of the following happened in your neighbourhood over the past 30 days you heard gunshots? (25)
	Have any of the following happened in your neighbourhood over the past 30 days you saw someone selling illegal drugs? (25)
	Have any of the following happened in your neighbourhood over the past 30 days someone tried to get you to break the law? (25)
	Have any of the following happened in your neighbourhood over the past 30 days a person was murdered? (25)
	Have any of the following happened in your neighbourhood over the past 30 days a fight broke out between two gangs? (25)
	Have any of the following happened in your neighbourhood over the past 30 days someone threatened you with a weapon such as a gun, knife or club? (25)
	Have any of the following happened in your neighbourhood over the past 30 days you saw someone threatened with a weapon such as a gun, knife or club? (25)

Item themes	**Questions (study)**
	Have any of the following happened in your neighbourhood over the past 30 days someone offered you an alcoholic beverage? (25)
	Have any of the following happened in your neighbourhood over the past 30 days someone tried to sell you illegal drugs? (25)
	Drug dealers near my home (26, 29)
	Strangers drunk near my house (26, 29)
	Adults arguing loudly on streets (26)
	Neighbours complain about crime (26,29)
	"Shooting gallery" near my home (26, 29)
	Someone arrested or in jail (26, 29)
	Gang fight near my home (26, 29)
	Cars speeding on my street (26)
	How often people drink alcohol on the streets in their neighbourhood?(28)
	How often someone gets robbed in their neighbourhood?(28)
	How often someone uses drugs in their neighbourhood?(28)
	How often the police arrest someone in their neighbourhood?(28)
	How often there is a fight in their neighbourhood?(28)
	How often someone steals something in their neighbourhood?(28)
Supervision/intervention	Would adults try to stop if someone was spray painting a wall in your neighbourhood? (2, 3)
	Would adults try to stop if someone was trying to steal a car in your neighbourhood? (2, 3)
	Would adults try to stop if teenagers were fighting in the street in your neighbourhood? (2, 3)
	Would someone call the police if someone was spray painting a wall in your neighbourhood? (2, 3)

Item themes	Questions (study)
	Would someone call the police if someone was trying to steal a car in your neighbourhood? (2, 3)
	Would someone call the police if teenagers were fighting in the street in your neighbourhood? (2, 3)
	If someone in my neighbourhood or community saw me doing something wrong, they would tell my parents (or adults who live with me) (13)
	How likely adults in their neighbourhood would be to intervene if children or teenagers were hanging out on the street? (14)
	How likely adults in their neighbourhood would be to intervene if children or teenagers spray painting graffiti? (14)
	How likely adults in their neighbourhood would be to intervene if children or teenagers showing disrespect to an adult? (14)
	How likely adults in their neighbourhood would be to intervene if children or teenagers fighting? (14)
	The adults in my neighbourhood reprimand us if we damage trees or public gardens(19)
	The adults in my neighbourhood would try to prevent young people from burning or breaking things (trashcan, etc.) (19)
	If a young person in my neighbourhood tried to damage a car, an adult would try to stop him/her(19)
	In my neighbourhood if you get into hooliganism an adult will scold you (19)
	If a group of children were skipping school and hanging out on the street corner, how likely is it a neighbour would do anything about it? (20)
	If some children were spray-painting graffiti on a local building, how likely is it that your neighbours would do something about it? (20)

Item themes	**Questions (study)**
	If a child was showing disrespect to an adult, how likely is it that people in your neighbourhood would scold that child? (20)
	If I did something wrong, adults in my neighbourhood who knew about it would probably tell the adults I live with (25)
	Adults in my neighbourhood would say something to me if they saw me doing something that could get me into trouble (25)
	Most adults in my community keep an eye on what kids are up to (32)
Enjoy neighbourhood	If, for any reason, you had to move from here to some other neighbourhood, how happy or unhappy would you be (6)
	On the whole, how happy are you living in your neighbourhood (6)
	Do you think the area in which you live is a good place to live?(7)
	Overall, how satisfied are you with your neighbourhood (9)
	How would you rate the physical appearance of your neighbourhood (9)
	If I had to move, I would miss the neighbourhood I live in now (10, 21, 27)
	I like the neighbourhood that I live in (10, 30)
	I like hanging out around where I live (11)
	I like my neighbourhood (21)
	I think this is a good place to live in (22,23)
	This is a pretty town (22,23)
	As compared to others my town has many advantages (22,23)
	Some of our local holidays and celebrations attract many people because they are very nice and well organized (22)
	I like to notice that when some local events are organized, many people participate and are involved (22)
	During local holiday celebrations, I feel proud to live here (22)
	I am happy with the neighbourhood I live in (25)

Item themes	**Questions (study)**
	I like the neighbourhood or the area where I live (27)
	It would take a lot for me to move away from this town (30)
Negative interpersonal connections	Adults in my neighbourhood don't care about people my age (1)
	My neighbours do not care what my friends do in this area (4)
	It is difficult for kids to make friends in my neighbourhood (4)
	Neighbours do not look out for others (5)
	Do not know most people in neighbourhood (5)
	Do not stop and talk to neighbours (5)
	People in this/my community like to gossip (17)
	People in this/my community know too much about each other's business (17)
	Once you get a bad reputation around here it is hard to get rid of (17)
	There are few chances to meet people in this town (30)
	In this town it is difficult to have good social relationships (30)
	I don't like the people in my area (30)
	Very few people in my neighbourhood know who I am (31)
	In my neighbourhood, away from school, people sometimes treat me unfairly because of my race or ethnicity (32)
Places to spend time and have needs met	I often spend time playing or doing things in my neighbourhood (11)
	There are good places to spend free time (8)
	There are places for kids my age to go that are alcohol and drug free (13)
	During vacation, there are many activities for young people to have fun in my neighbourhood (19)

Item themes	**Questions (study)**
	Young people in my neighbourhood have places to get together during bad weather (19)
	The young people in my neighbourhood can do so many things they rarely get bored (19)
	There are few neighbourhoods, such as my own, where there are as many activities for young people(19)
	In this town, there are many places loved and appreciated by all inhabitants (22)
	In this place, it is easy to find information about things that interest young people (22)
	In this place, young people can find many opportunities to amuse themselves (22,23)
	This place gives me opportunities to do many different things (22)
	There are activities that young people can do in my town (22)
	In this place, there are enough opportunities to meet other boys and girls (22,23)
	In this place, there are many situations and initiatives that involve young people like me (22, 23)
	In this place, there are enough initiatives for young people (22,23)
	This town gives me an opportunity to do a lot of different things (30)
	If I need help this town has many excellent services to meet my needs (30)
	In my neighbourhood, there are a lot of fun things for people my age to do (25)
Feeling of belonging	I identify with my community (19)
	I feel I am part of my community (19)
	I feel very connected to my neighbourhood (19)

Item themes	**Questions (study)**
	Living in my neighbourhood makes me feel that I am part of a community(19)
	I feel like I belong to this town (22,23)
	I think I have a lot in common with other young people that live here (22)
	The neighbourhood I live in is a big part of who I am (24)
	Living in this neighbourhood gives me a feeling of belonging (24)
	I feel like I belong here (30)
	I feel very identified with my neighbourhood (31)
	I feel that the neighbourhood belongs to me (31)
Safety	Do not feel safe in neighbourhood (5)
	Do you usually feel safe in your neighbourhood (6)
	I feel safe in the area that I live (7)
	It is safe for younger children to play outside during the day (7, 8)
	My community is safe (17)
	Some of my friends are afraid to come to my neighbourhood (19)
	I feel safe in my neighbourhood (21, 25)
	I feel safe here (22, 30)
	Generally, my neighbourhood is a safe place to live (32)
	I feel safe in my neighbourhood, or the place that I live (27)
Opportunities for collective influence	Honestly, I feel that if we engaged more, we would be able to improve things for young people in this town (22, 23)
	If only we had the opportunity, I think that we could be able to organize something special for our town (22, 23)
	If the people here were to organize, they would have good chance of reaching their desired goals (22, 23, 30)

Item themes	**Questions (study)**
	I think the people who live here could change things that are not properly working for the community (22, 23)
	If you want to, in this town it possible to participate in local politics (30)
	My opinions are well received in my neighbourhood(31)
Physical deterioration	There are empty and abandoned buildings in your neighbourhood (15)
	There is a lot of graffiti in your neighbourhood (15)
	How common is broken cars on the street (18)
	How common is houses looking like they need repair (18)
	How common is trash on the streets (18)
	Litter or trash on the sidewalks or streets in the neighbourhood (20)
	Graffiti on buildings and walls in the neighbourhood (20)
	What describes your neighbourhood: graffiti (21)
	What describes your neighbourhood: abandoned buildings (21)
	No. of vacant houses (26)
Youth involvement/engagement	I am interested in finding out about new things in my neighbourhood (16)
	Kids in my neighbourhood are involved in decision making (21)
	I take part in organizations in my community (31)
	I take part in social activities in my neighbourhood (31)
	I take part in social or citizen groups (31)
Do not enjoy neighbourhood	Would be happy to move (5)
	Not happy in neighbourhood (5)
	My neighbourhood is boring (11)
Shared values	I think of myself as the same as people in my neighbourhood (24)

Item themes	**Questions (study)**
	I think I agree with most people in my neighbourhood about what is important in life (24)
	I generally respect the habits and traditions of this town (30)
	There are some holidays or anniversary days that in this town that involve most people (30)
Prosocial behaviours	How likely are young people in the neighbourhood to make good grades? (25)
	How likely are young people in the neighbourhood to graduate from high school? (25)
	How likely are young people in the neighbourhood to find a job or go to college after completing high school? (25)
Contact with people within the neighbourhood	Frequency with neighbours within the community (20)
	Frequency with church leaders within the community (20)
	Frequency with community leaders within the community (20)
Residential mobility	People move in and out of your neighbourhood often (15)
	Families moving in and out of houses in your neighbourhood (18)
Willing to represent	If there is trouble I will represent my neighbourhood (24)
	I attend the calls for support made within my community (31)
Positive police views	Usually I can count on the police if am having a problem or need help (32)
Police complaints	People complain about police (26)
Non-engagement	I don't take part in my neighbourhood festive activities (31)
Enjoy house	I like the house in which I live (30)
Overcrowding	How common is 2 or 3 families living in one house (18)

Item themes	**Questions (study)**
Economic	Number of neighbours with food stamps (26)
Time spent in neighbourhood	I spend most of my free time in the neighbourhood where I live (24)

1. Crean (2012)
2. Neumann et al. (2010)
3. Barker et al. (2011)
4. Lee (2010)
5. van de Bree et al. (2009)
6. Ward and Laughlin (2003)
7. Nichol et al. (2010)
8. Vafaei et al. (2014)
9. Ceballo et al. (2004)
10. Choi et al. (2006)
11. Karcher and Sass (2010)
12. DeHaan and Boljevac (2010)
13. Meier et al (2008)
14. Kerrigan et al. (2006)
15. Winstanley et al. (2008)
16. Widome et al. (2008)
17. Van Gundy et al. (2011)
18. Vowell (2007)
19. Oliva et al. (2011)
20. Law and Barber (2007)
21. Baheiraei et al. (2014)
22. Albanesi et al. (2007)

23. Chessi et al. (2010)
24. Perez-Smith et al. (2001)
25. Anthony and Stone (2010)
26. Ewart and Suchday (2002)
27. Clark et al. (2011)
28. Wilson et al. (2004)
29. Suchday et al. (2010)
30. Zani et al. (2001)
31. Sorribas et al. (2014)
32. Mayberry et al. (2009)

Appendix D

Systematic review quality assessment

Table D.1: Quality assessment of studies for systematic review

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
K. Koutra, G. Kritsotakis, P. Orfanos, N. Ratsika, A. Kokkevi and A. Philalithis	2014	Social capital and regular alcohol use and binge drinking in adolescence: A cross-sectional study in Greece	E	E	P	NA	P	P	NA	E	n
J. Onyx, C. Wood, P. Bullen and L. Osburn	2005	Social capital : a rural youth perspective	G	F	P	NA	E	P	P	E	n
D. Azrael, R. M. Johnson, B. E. Molnar, M. Vriniotis, E. C. Dunn, D. T. Duncan and D. Hemenway	2009	Creating a youth violence data system for Boston, Massachusetts	G	F	P	NA	P	P	NA	E	n
B. K. Barber	2001	Political violence, social integration, and youth functioning: Palestinian youth from the Intifada	G	F	P	NA	P	P	NA	E	n
E. D. Barker, C. J. Trentacosta and R. T. Salekin	2011	Are impulsive adolescents differentially influenced by the good and bad of neighborhood and family?	E	G	E	E	E	E	E	E	y
S. Browning and P. Erickson	2009	Neighborhood disadvantage, alcohol use, and violent victimization	G	F	P	NA	P	P	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
H. L. Chung and L. Steinberg	2006	Relations between Neighborhood Factors, Parenting Behaviors, Peer Deviance, and Delinquency among Serious Juvenile Offenders	E	E	E	E	P	NA	NA	E	n
C. Donath, E. Grässel, D. Baier, C. Pfeiffer, S. Bleich and T. Hillemacher	2012	Predictors of binge drinking in adolescents: ultimate and distal factors - a representative study	G	F	E	E	P	NA	NA	E	n
S. R. L. Johnson, N. M. Finigan, C. P. Bradshaw, D. L. Haynie and T. L. Cheng	2011	Examining the link between neighborhood context and parental messages to their adolescent children about violence	E	E	E	E	P	NA	NA	E	n
D. Kerrigan, S. Witt, B. Glass, S.-E. Chung and J. Ellen	2006	Perceived neighborhood social cohesion and condom use among adolescents vulnerable to HIV/STI	G	F	E	E	E	E	E	F	y
C. H. Lee	2011	An Ecological Systems Approach to Bullying Behaviors Among Middle School Students in the United States	G	F	E	E	E	E	E	G	y
A. Neumann, E. D. Barker, H. M. Koot and B. Maughan	2010	The role of contextual risk, impulsivity, and parental knowledge in the development of adolescent antisocial behavior	E	G	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
D. T. O'Brien, A. C. Gallup and D. S. Wilson	2012	Residential mobility and prosocial development within a single city	G	F	E	E	P	NA	NA	E	n
D. T. O'Brien and R. A. Kauffman, Jr.	2013	Broken windows and low adolescent prosociality: Not cause and consequence, but co-symptoms of low collective efficacy	G	F	E	E	P	NA	NA	E	n
A. R. Piquero, W. G. Jennings, N. L. Piquero and C. A. Schubert	2014	Human but not social capital is better able to distinguish between offending trajectories in a sample of serious adolescent Hispanic offenders	G	F	E	E	P	NA	NA	E	n
R. L. Simons and C. H. Burt	2011	Learning to be bad: Adverse social conditions, social schemas, and crime	G	G	E	E	P	NA	NA	E	n
R. L. Simons, M. K. Lei, S. R. H. Beach, G. H. Brody, R. A. Philibert and F. X. Gibbons	2011	Social Environment, Genes, and Aggression: Evidence Supporting the Differential Susceptibility Perspective	G	G	E	E	P	NA	NA	E	n
R. L. Simons, M. K. Lei, E. A. Stewart, S. R. H. Beach, G. H. Brody, R. A. Philibert and F. X. Gibbons	2012	Social adversity, genetic variation, street code, and aggression: A genetically informed model of violent behavior	G	G	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
S. M. Snyder and B. Freisthler	2011	Are nonprofit density and nonprofit expenditures related to youth deviance?	E	E	E	E	P	NA	NA	E	n
C. J. Tompsett, K. E. Amrhein and S. Hassan	2014	Travel beyond the home neighborhood for delinquent behaviors: moderation of home neighborhood influences	E	G	E	E	P	NA	NA	E	n
D. H. Bernat, J. M. Oakes, S. L. Pettingell and M. Resnick	2012	Risk and direct protective factors for youth violence: Results from the National Longitudinal Study of Adolescent Health	G	F	P	NA	P	NA	NA	E	n
C. L. Broman, X. Li and M. Reckase	2008	Family Structure and Mediators of Adolescent Drug Use	G	F	E	E	P	NA	NA	E	n
P. Chen and K. C. Jacobson	2013	Impulsivity Moderates Promotive Environmental Influences on Adolescent Delinquency: A Comparison Across Family, School, and Neighborhood Contexts	E	G	E	E	P	NA	NA	E	n
A. R. Deutsch, L. J. Crockett, J. M. Wolff and S. T. Russell	2012	Parent and Peer Pathways to Adolescent Delinquency: Variations by Ethnicity and Neighborhood Context	G	E	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
N. N. Duke, C. L. Skay, S. L. Pettingell and I. W. Borowsky	2009	From adolescent connections to social capital: Predictors of civic engagement in young adulthood	E	G	E	E	P	NA	NA	E	n
T. M. Franke, A.-L. T. Huynh-Hohnbaum and Y. Chung	2002	Adolescent Violence: With Whom They Fight and Where	G	F	P	NA	P	NA	NA	E	n
J. M. Gerard and C. Buehler	2004	Cumulative environmental risk and youth problem behavior	E	E	P	NA	P	NA	NA	E	n
J. M. Gerard and C. Buehler	2004	Cumulative environmental risk and youth maladjustment: the role of youth attributes	E	E	P	NA	P	NA	NA	E	n
J. Kim, J. H. Liu, N. Colabianchi and R. R. Pate	2010	The Effect of Perceived and Structural Neighborhood Conditions on Adolescents' Physical Activity and Sedentary Behaviors	E	E	P	NA	P	NA	NA	E	n
J. D. Patton	2013	Support for resilience theory with female adolescents who are violent: A MIMIC model	E	G	P	NA	P	NA	NA	E	n
B. Teasdale and E. Silver	2009	Neighborhoods and Self-Control: Toward an Expanded view of socialization	E	G	E	E	P	NA	NA	E	n
M. B. van den Bree, K. Shelton, A. Bonner, S. Moss, H. Thomas and P. J. Taylor	2009	A longitudinal population-based study of factors in adolescence predicting homelessness in young adulthood	E	E	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
C. L. Ward and J. E. Laughlin	2003	Social contexts, age and juvenile delinquency: A community perspective	G	E	E	E	E	E	E	E	y
H. Weiss	2011	Adolescents as a source of social control: The utility of adolescent social capital for reducing violent delinquency	E	E	P	NA	E	P	E	E	n
H. E. Weiss	2012	The intergenerational transmission of social capital: A developmental approach to adolescent social capital formation	G	E	P	NA	E	P	NA	E	n
D. R. Wright and K. M. Fitzpatrick	2006	Social Capital and Adolescent Violent Behavior: Correlates of Fighting and Weapon Use among Secondary School Students	G	F	E	E	P	NA	NA	E	n
M. W. Arthur, J. S. Briney, D. J. Hawkins, R. D. Abbott, B. L. Brooke-Weiss and R. F. Catalano	2007	Measuring Risk and Protection in Communities Using the Communities that Care Youth Survey	G	F	P	NA	P	NA	NA	E	n
A. Baheiraei, F. Soltani, A. Ebadi, M. A. Cheraghi, A. R. Foroushani and R. F. Catalano	2014	Psychometric properties of the Iranian version of 'Communities That Care Youth Survey'	G	E	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
F. Z. Belgrave, J. Johnson, A. Nguyen, K. Hood, R. Tademy, T. Clark and A. Nasim	2010	Stress and Tobacco Use among African-American Adolescents: The Buffering Effect of Cultural Factors	G	F	E	E	P	NA	NA	E	n
J. M. Beyers, J. W. Toumbourou, R. F. Catalano, M. W. Arthur and J. D. Hawkins	2004	A cross-national comparison of risk and protective factors for adolescent substance use: the United States and Australia	G	F	E	E	P	NA	NA	E	n
J. Brevard, M. Maxwell, K. Hood and F. Belgrave	2013	Feeling safe: Intergenerational connections and neighborhood disorganization among urban and rural African American youth	G	F	E	E	P	NA	NA	E	n
J. S. Briney, E. C. Brown, J. D. Hawkins and M. W. Arthur	2012	Predictive validity of established cut points for risk and protective factor scales from the Communities That Care Youth Survey	E	E	P	NA	P	NA	NA	E	n
H. Champion, K. L. Foley, K. Sigmon-Smith, E. L. Sutfin and R. H. DuRant	2008	Contextual factors and health risk behaviors associated with date fighting among high school students	G	F	E	E	P	NA	NA	E	n
T. T. Clark, A. B. Nguyen and F. Z. Belgrave	2011	Risk and protective factors for alcohol and marijuana use among African-American rural and urban adolescents	G	F	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
M. J. Cleveland, L. M. Collins, S. T. Lanza, M. T. Greenberg and M. E. Feinberg	2010	Does individual risk moderate the effect of contextual-level protective factors? A latent class analysis of substance use	E	G	E	E	P	NA	NA	E	n
M. J. Cleveland, M. E. Feinberg, D. E. Bontempo and M. T. Greenberg	2008	The role of risk and protective factors in substance use across adolescence	G	F	E	E	P	NA	NA	E	n
M. J. Corrigan, B. Loneck and L. Videka	2007	The Development and Preliminary Validation of the Adolescent Domain Screening Inventory. A Substance Use Prevention Tool	E	E	P	NA	E	P	E	E	n
I. Crow, A. France and S. Hacking	2006	Evaluation of Three Communities That Care Projects in the U.K	G	F	P	NA	P	NA	NA	E	n
A. A. Fagan, L. M. Van Horn, D. J. Hawkins and M. Arthur	2007	Using Community and Family Risk and Protective Factors for Community-Based Prevention Planning	G	E	P	NA	P	NA	NA	E	n
A. A. Fagan, M. L. van Horn, J. David Hawkins and T. Jaki	2013	Differential Effects of Parental Controls on Adolescent Substance Use: For Whom is the Family Most Important?	G	F	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
M. E. Feinberg, D. Jones, M. T. Greenberg, D. W. Osgood and D. Bontempo	2010	Effects of the Communities That Care model in Pennsylvania on change in adolescent risk and problem behaviors	G	G	P	NA	P	NA	NA	E	n
M. E. Feinberg, T. A. Ridenour and M. T. Greenberg	2007	Aggregating indices of risk and protection for adolescent behavior problems: The communities that care youth survey	G	F	E	E	P	NA	NA	E	n
R. R. Glaser, M. L. V. Horn, M. W. Arthur, J. D. Hawkins and R. F. Catalano	2005	Measurement properties of the Communities That Care® Youth survey across demographic groups	E	E	P	NA	E	P	E	E	n
S. A. Hemphill, R. Smith, J. W. Toumbourou, T. I. Herrenkohl, R. F. Catalano, B. J. McMorris and H. Romaniuk	2009	Modifiable determinants of youth violence in Australia and the United States: A longitudinal study	E	E	E	E	P	NA	NA	E	n
S. A. Hemphill, J. W. Toumbourou, T. I. Herrenkohl, B. J. McMorris and R. F. Catalano	2006	The Effect of School Suspensions and Arrests on Subsequent Adolescent Antisocial Behavior in Australia and the United States	E	E	E	E	P	NA	NA	E	n
H. Jonkman, M. Steketee, J. W. Tombourou, K. Cini and J. Williams	2014	Community variation in adolescent alcohol use in Australia and the Netherlands	G	F	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
S. T. Lanza, B. R. Cooper and B. C. Bray	2014	Population heterogeneity in the salience of multiple risk factors for adolescent delinquency	E	E	E	E	P	NA	NA	E	n
E. Leslie, P. Kremer, J. W. Toumbourou and J. W. Williams	2010	Gender differences in personal, social and environmental influences on active travel to and from school for Australian adolescents	G	F	P	NA	P	NA	NA	E	n
E. R. Maguire, W. Wells and C. M. Katz	2011	Measuring Community Risk and Protective Factors for Adolescent Problem Behaviors: Evidence from a Developing Nation	G	G	P	NA	E	P	E	E	n
M. R. Moore	2003	Socially isolated? How parents and neighbourhood adults influence youth behaviour in disadvantaged communities	G	F	P	NA	P	NA	NA	E	n
N. K. Morojele, A. J. Flisher, M. Muller, C. F. Ziervogel, P. Reddy and C. J. Lombard	2002	Measurement of risk and protective factors for drug use and anti-social behavior among high school students in South Africa	G	F	E	G	P	NA	NA	E	n
A. Nasim, B. M. Berry, F. Z. Belgrave, R. Corona and E. Turf	2010	Ethnic considerations in risk exposure and cigarette use vulnerability among eighth grade students in Virginia	G	F	P	NA	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
A. N. Peterson, C. H. Peterson, L. Agre, B. D. Christens and C. M. Morton	2011	Measuring Youth Empowerment: Validation of a Sociopolitical Control Scale for Youth in an Urban Community Context	G	F	E	E	P	NA	NA	E	n
K. E. Scholes-Balog, S. Hemphill, S. Reid, G. Patton and J. Toumbourou	2013	Predicting early initiation of alcohol use: A prospective study of Australian children	G	F	E	E	P	NA	NA	E	n
N. Takviriyanun, R. Phuphaibul, A. M. Villarruel, T. Vorapongsathorn and R. Panitrat	2007	How do environmental risks and resilience factors affect alcohol use among Thai adolescents?	G	F	E	E	P	P	NA	E	n
W. F. Boyce, D. Davies, O. Gallupe and D. Shelley	2008	Adolescent risk taking, neighborhood social capital, and health	G	F	E	E	P	NA	NA	E	n
F. M. Brooks, J. Magnusson, N. Spencer and A. Morgan	2012	Adolescent multiple risk behaviour: an asset approach to the role of family, school and community	G	F	P	NA	P	NA	NA	E	n
L. Dallago, D. D. Perkins, M. Santinello, W. Boyce, M. Molcho and A. Morgan	2009	Adolescent place attachment, social capital, and perceived safety: A comparison of 13 countries	G	F	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
F. J. Elgar, S. J. Trites and W. Boyce	2010	Social capital reduces socio-economic differences in child health: evidence from the Canadian Health Behaviour in School-Aged Children study	G	F	P	NA	P	NA	NA	E	n
U. Eriksson, J. Hochwalder, A. Carlsund and E. Sellstrom	2012	Health outcomes among Swedish children: the role of social capital in the family, school and neighbourhood	G	F	E	E	P	NA	NA	E	n
U. Eriksson, J. Hochwalder and E. Sellstrom	2011	Perceptions of community trust and safety - consequences for children's well-being in rural and urban contexts	G	F	E	E	P	NA	NA	E	n
I. García-Moya, C. Moreno and O. Braun-Lewensohn	2013	Neighbourhood perceptions and sense of coherence in adolescence	G	F	E	E	P	NA	NA	E	n
I. García-Moya, C. Moreno and A. Jiménez-Iglesias	2013	Understanding the joint effects of family and other developmental contexts on the sense of coherence (SOC): a person-focused analysis using the Classification Tree	G	F	E	E	P	NA	NA	E	n
I. Janssen	2014	Crime and perceptions of safety in the home neighborhood are independently associated with physical activity among 11-15year olds	E	E	P	NA	E	E	E	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
M. Lenzi, A. Vieno, D. D. Perkins, M. Santinello, F. J. Elgar, A. Morgan and S. Mazzardis	2012	Family affluence, school and neighborhood contexts and adolescents civic engagement: A cross-national study	E	E	E	E	P	E	E	E	n
A. Morgan and B. J. A. Haglund	2009	Social capital does matter for adolescent health: Evidence from the English HBSC study	G	F	P	NA	P	NA	NA	NA	n
A. R. Morgan, F. Rivera, C. Moreno and B. J. A. Haglund	2012	Does social capital travel? Influences on the life satisfaction of young people living in England and Spain	G	F	P	NA	P	NA	NA	NA	n
M. Nichol, I. Janssen and W. Pickett	2010	Associations between neighborhood safety, availability of recreational facilities, and adolescent physical activity among Canadian youth	G	G	E	E	E	E	E	E	y
L. Schumann, W. Craig and A. Rosu	2014	Power Differentials in Bullying: Individuals in a Community Context	G	F	P	NA	NA	P	NA	NA	n
A. Vafaei, W. Pickett and B. E. Alvarado	2014	Neighbourhood environment factors and the occurrence of injuries in Canadian adolescents: a validation study and exploration of structural confounding	E	G	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
J. K. Bass and S. F. Lambert	2004	Urban Adolescents' Perceptions of Their Neighborhoods: An Examination of Spatial Dependence	E	E	E	E	P	NA	NA	E	n
T. Abada, F. Hou and B. Ram	2007	Racially mixed neighborhoods, perceived neighborhood social cohesion, and adolescent health in Canada	G	F	P	NA	P	NA	NA	E	n
E. K. Adam and P. L. Chase-Lansdale	2002	Home sweet home(s): parental separations, residential moves, and adjustment problems in low-income adolescent girls	E	E	E	E	P	NA	NA	E	n
M. R. Moore and L. P. Chase-Lansdale	2001	Sexual Intercourse and Pregnancy among African American Girls in High-Poverty Neighborhoods: The Role of Family and Perceived Community Environment	E	E	E	E	P	NA	NA	E	n
C. Albanesi, E. Cicognani and B. Zani	2007	Sense of community, civic engagement and social well-being in Italian adolescents	G	F	E	E	E	E	E	E	y
M. Chiessi, E. Cicognani and C. Sonn	2010	Assessing Sense of Community on Adolescents: Validating the Brief Scale of Sense of Community in Adolescents (SOC-A)	G	F	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
E. Cicognani, C. Albanesi and B. Zani	2008	The impact of residential context on adolescents' subjective well being	G	F	E	E	P	NA	NA	E	n
A. Vieno, M. Lenzi, N. Canale and M. Santinello	2014	ITALIAN VALIDATION OF THE SOCIOPOLITICAL CONTROL SCALE FOR YOUTH (SPCS-Y)	G	F	E	E	P	NA	NA	E	n
V. L. Banyard and K. L. Modecki	2006	Interpersonal violence in adolescence - Ecological correlates of self-reported perpetration	G	G	E	E	P	NA	NA	E	n
I. J. Chung, K. G. Hill, J. D. Hawkins, L. D. Gilchrist and D. S. Nagin	2002	Childhood predictors of offense trajectories	E	E	P	NA	P	NA	NA	E	n
T. I. Herrenkohl, H. Guo, R. Kosterman, J. D. Hawkins, R. F. Catalano and B. H. Smith	2001	Early adolescent predictors of youth violence as mediators of childhood risks	E	E	E	E	P	NA	NA	E	n
T. I. Herrenkohl, D. Hawkins, R. D. Abbott and J. Guo	2002	Correspondence between youth report and census measures of neighborhood context	G	G	P	NA	P	NA	NA	E	n
E. K. Anthony and S. I. Stone	2010	Individual and contextual correlates of adolescent health and well-being	G	G	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
G. L. Bowen, R. A. Rose, J. D. Powers and E. J. Glennie	2008	The joint effects of neighborhoods, schools, peers, and families on changes in the school success of middle school students	E	E	E	E	P	NA	NA	E	n
N. K. Bowen, G. L. Bowen and W. Ware	2002	Neighborhood social disorganization, families, and the educational behavior of adolescents	E	E	E	E	P	NA	MA	E	n
M. V. Chapman	2003	Social Support and Loss During Adolescence: How Different Are Teen Girls from Boys?	G	F	P	NA	P	NA	NA	E	n
M. V. Chapman	2005	Neighborhood quality and somatic complaints among American youth	G	F	E	E	P	NA	NA	E	n
P. Garcia-Reid	2007	Examining Social Capital as a Mechanism for Improving School Engagement among Low Income Hispanic Girls	G	F	E	E	P	NA	NA	E	n
P. Garcia-Reid, R. J. Reid and N. Andrew Peterson	2005	School engagement among Latino youth in an urban middle school context: Valuing the role of social support	G	F	E	E	P	NA	NA	E	n
A. Grogan-Kaylor and M. E. Woolley	2010	The Social Ecology of Race and Ethnicity School Achievement Gaps: Economic, Neighborhood, School, and Family Factors	G	F	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
J. K. Nash	2002	Neighborhood effects on sense of school coherence and educational behavior in students at risk of school failure	G	F	P	NA	P	NA	NA	E	n
N. Nicotera, L. R. Williams and E. Anthony	2013	Ecology of youth collective socialization	E	E	P	NA	P	NA	NA	E	n
R. A. Rose, M. E. Woolley and G. L. Bowen	2013	Social capital as a portfolio of resources across multiple microsystems: Implications for middle-school students	E	E	E	E	P	NA	NA	E	n
K. Aminzadeh, S. Denny, J. Utter, T. L. Milfont, S. Ameratunga, T. Teevale and T. Clark	2013	Neighbourhood social capital and adolescent self-reported wellbeing in New Zealand: A multilevel analysis... [corrected] [published erratum appears in SOC SCI MED 2013; 101]	G	G	E	E	P	NA	NA	E	n
J. Utter, S. Denny, E. Robinson, S. Ameratunga and T. L. Milfont	2011	Social and physical contexts of schools and neighborhoods: Associations with physical activity among young people in New Zealand	E	E	E	E	P	NA	NA	E	n
E. K. Anthony and D. E. Robbins	2013	A latent class analysis of resilient development among early adolescents living in public housing	G	E	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
C. Åslund and K. W. Nilsson	2013	Social capital in relation to alcohol consumption, smoking, and illicit drug use among adolescents: a cross-sectional study in Sweden	G	G	E	E	P	NA	NA	E	n
C. Aslund, B. Starrin and K. W. Nilsson	2010	Social capital in relation to depression, musculoskeletal pain, and psychosomatic symptoms: a cross-sectional study of a large population-based cohort of Swedish adolescents	G	F	E	E	P	NA	NA	E	n
O. Braun-Lewensohn, S. Sagi, H. Sabato and R. Galili	2013	Sense of coherence and sense of community as coping resources of religious adolescents before and after the disengagement from the Gaza Strip	G	F	E	E	P	NA	NA	E	n
A. K. Burlew, C. S. Johnson, A. M. Flowers, B. J. Peteet, K. D. Griffith-Henry and N. D. Buchanan	2009	Neighborhood Risk, Parental Supervision and the Onset of Substance Use among African American Adolescents	G	F	E	G	P	NA	NA	E	n
A. Carver, A. Timperio and D. Crawford	2008	Perceptions of neighborhood safety and physical activity among youth: The CLAN study	G	G	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
R. Ceballo, V. C. McLoyd and T. Toyokawa	2004	The Influence of Neighborhood Quality on Adolescents' Educational Values and School Effort	G	F	E	E	E	E	E	E	y
N. R. Chaumeton, S. K. Ramowski and R. J. Nystrom	2011	Correlates of Gambling among Eighth-Grade Boys and Girls	G	F	P	NA	P	NA	NA	E	n
C.-Y. Chen, C.-C. Wu, H.-Y. Chang and L.-L. Yen	2014	The effects of social structure and social capital on changes in smoking status from 8th to 9th grade: results of the Child and Adolescent Behaviors in Long-term Evolution (CABLE) study	E	E	E	E	P	NA	NA	E	n
H. M. Chipuer, P. Bramston and G. Pretty	2003	Determinants of subjective quality of life among rural adolescents: A developmental perspective	G	F	E	E	P	NA	NA	E	n
Y. Choi, T. W. Harachi and R. F. Catalano	2006	Neighborhoods, family, and substance use: Comparisons of the relations across racial and ethnic groups	G	E	E	E	E	E	E	E	y
N. Copeland-Linder, S. F. Lambert, Y. F. Chen and N. S. Ialongo	2011	Contextual Stress and Health Risk Behaviors Among African American Adolescents	E	E	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
H. F. Crean	2012	Youth activity involvement, neighborhood adult support, individual decision making skills, and early adolescent delinquent behaviors: Testing a conceptual model			E	E	E	E	E	E	y
B. P. Daly, R. Q. Shin, C. Thakral, M. Selders and E. Vera	2009	School Engagement Among Urban Adolescents of Color: Does Perception of Social Support and Neighborhood Safety Really Matter?	G	G	E	E	P	NA	NA	E	n
L. De Haan, T. Boljevac and K. Schaefer	2009	Rural Community Characteristics, Economic Hardship, and Peer and Parental Influences in Early Adolescent Alcohol Use	G	F	E	E	P	NA	NA	E	n
A. Dulin-Keita, H. Kaur Thind, O. Affuso and M. L. Baskin	2013	The associations of perceived neighborhood disorder and physical activity with obesity among African American adolescents	E	E	E	E	P	NA	NA	E	n
T. El Hajj, R. A. Afifi, M. Khawaja and T. Harpham	2011	Violence and social capital among young men in Beirut	G	F	P	NA	P	NA	NA	E	n
E. Estevez and N. P. Emler	2010	A Structural Modelling Approach to Predict Adolescent Offending Behaviour from Family, School and Community Factors	G	F	P	NA	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
C. Ewart, G. Elder and J. Smyth	2014	How neighborhood disorder increases blood pressure in youth: agonistic striving and subordination	G	F	E	E	P	NA	NA	E	n
C. K. Ewart and S. Suchday	2002	Discovering how urban poverty and violence affect health: Development and validation of a neighborhood stress index	G	F	E	E	E	E	G	E	y
J. Fagg, S. Curtis, C. Clark, P. Congdon and S. A. Stansfeld	2008	Neighbourhood perceptions among inner-city adolescents: Relationships with their individual characteristics and with independently assessed neighbourhood conditions	G	G	E	E	P	NA	NA	E	n
C. J. Ferguson, C. S. Miguel and R. D. Hartley	2009	A multivariate analysis of youth violence and aggression: The influence of family, peers, depression, and media violence	G	F	E	E	P	NA	NA	E	n
K. M. Fitzpatrick, W. Choudary, A. Kearney and B. F. Piko	2013	Risks, Assets, and Negative Health Behaviors Among Arkansas' Hispanic Adolescents	G	F	E	E	P	NA	NA	E	n
C. A. Flanagan, P. Cumsille, S. Gill and L. S. Gallay	2007	School and Community Climates and Civic Commitments: Patterns for Ethnic Minority and Majority Students	E	G	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
D. M. Foney and M. Cunningham	2002	Why Do Good Kids Do Bad Things? Considering Multiple Contexts in the Study of Antisocial Fighting Behaviors in African American Urban Youth	E	E	E	G	P	NA	NA	E	n
P. Garcia-Reid, C. H. Peterson, R. J. Reid and N. A. Peterson	2013	The protective effects of sense of community, multigroup ethnic identity, and self-esteem against internalizing problems among Dominican youth: Implications for social workers	E	E	E	E	P	NA	NA	E	n
M. Han and S. Stone	2007	Access to Psycho-social Services Among Pregnant and Parenting Teens: Generating Questions Using Youth Reports and GIS Mapping Techniques	G	F	E	G	P	NA	NA	E	n
T. J. Holt, M. G. Turner and M. L. Exum	2014	The Impact of Self Control and Neighborhood Disorder on Bullying Victimization	E	E	E	E	P	NA	NA	E	n
A. K. Ivert and M. T. Levander	2014	Adolescents' Perceptions of Neighbourhood Social Characteristics-Is There a Correlation with Mental Health?	G	G	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
M. J. Karcher and D. Sass	2010	A multicultural assessment of adolescent connectedness: testing measurement invariance across gender and ethnicity	E	E	E	E	E	E	E	E	y
J. C. Kerr, R. F. Valois, A. Siddiqi, P. Vanable and M. P. Carey	2014	Neighborhood Condition and Geographic Locale in Assessing HIV/STI Risk Among African American Adolescents	G	F	E	E	P	NA	NA	E	n
M. Khawaja, S. Abdulrahim, R. A. Soweid and D. Karam	2006	Distrust, social fragmentation and adolescents' health in the outer city: Beirut and beyond	G	F	E	E	P	NA	NA	E	n
J. Lane	2009	Perceptions of neighborhood problems, fear of crime, and resulting behavioral precautions: Comparing institutionalized girls and boys in Florida	G	F	P	NA	P	NA	NA	E	n
D. L. Lang, L. F. Salazar, R. A. Crosby, R. J. DiClemente, L. K. Brown and G. R. Donenberg	2010	Neighborhood environment, sexual risk behaviors and acquisition of sexually transmitted infections among adolescents diagnosed with psychological disorders	G	F	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
D. L. Lang, J. M. Sales, L. F. Salazar, R. J. DiClemente, R. A. Crosby, L. K. Brown and G. R. Donenberg	2011	Determinants of multimethod contraceptive use in a sample of adolescent women diagnosed with psychological disorders	G	G	E	E	P	NA	NA	E	n
J. H. J. Law and B. K. Barber	2007	Neighborhood conditions, parenting, and adolescent functioning	E	E	E	E	E	E	E	E	y
M. Lenzi, A. Vieno, M. Pastore and M. Santinello	2013	Neighborhood social connectedness and adolescent civic engagement: An integrative model	G	G	E	E	P	NA	NA	E	n
M. Lenzi, A. Vieno, D. D. Perkins, M. Pastore, M. Santinello and S. Mazzardis	2012	Perceived neighborhood social resources as determinants of prosocial behavior in early adolescence	G	E	E	E	P	NA	NA	E	n
M. Lenzi, A. Vieno, M. Santinello and D. D. Perkins	2013	How neighborhood structural and institutional features can shape neighborhood social connectedness: A multilevel study of adolescent perceptions	G	G	E	E	P	NA	NA	E	n
G. A. Lowe, G. Lipps, R. C. Gibson, S. Halliday, A. Morris, N. Clarke and R. N. Wilson	2014	Neighbourhood factors and depression among adolescents in four Caribbean countries	G	F	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
A. Martin-Storey and R. Crosnoe	2014	Perceived Neighborhood Safety and Adolescent School Functioning	G	E	E	E	P	NA	NA	E	n
M. H. Meier, W. S. Slutske, S. Arndt and R. J. Cadoret	2008	Impulsive and callous traits are more strongly associated with delinquent behavior in higher risk neighborhoods among boys and girls	E	E	E	E	E	E	E	E	y
Z. R. Mello and D. P. Swanson	2007	Gender Differences in African American Adolescents' Personal, Educational, and Occupational Expectations and Perceptions of Neighborhood Quality	G	G	E	E	P	NA	NA	E	n
V. Nebbitt	2009	Self-Efficacy in African American Adolescent Males Living in Urban Public Housing	E	E	E	E	P	NA	NA	E	n
V. E. Nebbitt and M. Lombe	2007	Environmental correlates of depressive symptoms among African American adolescents living in public housing	G	F	E	E	P	NA	NA	E	n
V. E. Nebbitt and M. Lombe	2010	Urban African American adolescents and adultification	E	E	E	E	P	NA	NA	E	n
A. Oliva, L. Antolin and A. M. Lopez	2012	Development and Validation of a Scale for the Measurement of Adolescents' Developmental Assets in the Neighborhood	G	F	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
P. C. P. Paiva, H. N. d. Paiva, P. M. d. Oliveira Filho, J. A. Lamounier, E. F. E. Ferreira, R. C. Ferreira, I. Kawachi and P. M. Zarzar	2014	Development and Validation of a Social Capital Questionnaire for Adolescent Students (SCQ-AS)	G	F	P	NA	E	E	E	E	n
A. M. Perez-Smith, K. E. Albus and M. D. Weist	2001	Exposure to violence and neighborhood affiliation among inner-city youth	E	E	E	E	E	E	E	E	y
G. H. Pretty, H. M. Chipuer and P. Bramston	2003	Sense of place amongst adolescents and adults in two rural Australian towns: The discriminating features of place attachment, sense of community and place dependence in relation to place identity	E	E	E	E	P	NA	NA	E	n
R. G. Prins, M. A. Beenackers, M. C. Boog, F. J. Van Lenthe, J. Brug and A. Oenema	2014	Neighbourhood social capital as a moderator between individual cognitions and sports behaviour among Dutch adolescents	E	E	E	E	P	NA	NA	E	n
R. G. Prins, S. M. Mohnen, F. J. van Lenthe, J. Brug and A. Oenema	2012	Are neighbourhood social capital and availability of sports facilities related to sports participation among Dutch adolescents?	E	E	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
R. E. Roberts, C. R. Roberts and Y. Xing	2010	One-year incidence of suicide attempts and associated risk and protective factors among adolescents	G	F	E	E	P	NA	NA	E	n
C. G. Roman, M. Stodolska, J. Yahner and K. Shinew	2013	Pathways to Outdoor Recreation, Physical Activity, and Delinquency Among Urban Latino Adolescents	G	G	E	E	P	NA	NA	E	n
S. Sagy	2002	Moderating factors explaining stress reactions: Comparing chronic-without-acute-stress and chronic-with-acute-stress situations	G	F	E	E	P	NA	NA	E	n
S. Sagy and O. Braun-Lewensohn	2009	Adolescents under rocket fire: when are coping resources significant in reducing emotional distress?	G	F	E	E	P	NA	NA	E	n
K. J. Shinew, M. Stodolska, C. G. Roman and J. Yahner	2013	Crime, physical activity and outdoor recreation among Latino adolescents in Chicago	G	G	E	E	P	NA	NA	E	n
L. A. Slocum, T. J. Taylor, B. T. Brick and F.-A. Esbensen	2010	Neighborhood structural characteristics, individual?level attitudes, and youths' crime reporting intentions	E	E	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
A. R. Stiffman, B. Alexander-Eitzman, H. Silmere, V. Osborne and E. Brovin	2007	From early to late adolescence: American Indian youths' behavioral trajectories and their major influences	G	E	E	E	P	NA	NA	E	n
L. Strohschein and A. Matthew	2014	Adolescent Problem Behavior in Toronto, Canada: Associations with Family, School, and Neighborhood Social Capital Adolescent Problem Behavior in Toronto, Canada: Associations with Family, School, and Neighborhood Social Capital Lisa Strohschein and Alvinelle Matthew	E	E	E	E	P	NA	NA	E	n
S. Suchday, S. Kapur, C. K. Ewart and J. P. Friedberg	2006	Urban Stress and Health in Developing Countries: Development and Validation of a Neighborhood Stress Index for India	G	F	E	E	E	E	E	E	y
R. Tewksbury, G. E. Higgins and D. P. Connor	2013	Number of sexual partners and social disorganization: A developmental trajectory approach	E	G	E	E	P	NA	NA	E	n
K. T. Van Gundy, N. F. Stracuzzi, C. J. Rebellon, C. J. Tucker and E. S. Cohn	2011	Perceived Community Cohesion and the Stress Process in Youth	E	E	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
A. T. Vazsonyi, E. Trejos-Castillo and M. A. Young	2008	Rural and Non-Rural African American Youth: Does Context Matter in the Etiology of Problem Behaviors?	G	F	E	E	P	NA	NA	E	n
P. R. Vowell	2007	A partial test of an integrative control model: Neighborhood context, social control, self-control, and youth violent behavior	E	E	E	E	E	E	E	E	y
R. White and K. Renk	2012	Externalizing Behavior Problems during Adolescence: An Ecological Perspective	G	F	E	E	P	NA	NA	E	n
R. Widome, R. E. Sieving, S. A. Harpin and M. O. Hearst	2008	Measuring neighborhood connection and the association with violence in young adolescents	G	F	E	E	E	E	E	E	y
L. G. Wild, A. J. Flisher and B. A. Robertson	2013	Risk and Resilience in Orphaned Adolescents Living in a Community Affected by AIDS	G	F	E	E	P	NA	NA	E	n
E. L. Winstanley, D. M. Steinwachs, M. E. Ensminger, C. A. Latkin, M. L. Stitzer and Y. Olsen	2008	The association of self-reported neighborhood disorganization and social capital with adolescent alcohol and drug use, dependence, and access	G	E	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
D. A. Wright, G. Bobashev and R. Folsom	2007	Understanding the relative influence of neighborhood, family, and youth and adolescent drug use	G	F	P	NA	P	NA	NA	E	n
P. Wu, B. J. Katic, X. Liu, B. Fan and C. J. Fuller	2010	Mental health service use among suicidal adolescents: Findings from a U.S. national community survey	G	F	E	E	P	NA	NA	E	n
Q. Wu, B. Tsang and H. Ming	2012	Contributions of family and neighbourhood factors to the mental health of migrant children in China: Implications for policy and services	G	F	P	NA	E	E	E	E	n
Q. Wu, B. Tsang and H. Ming	2014	Social Capital, Family Support, Resilience and Educational Outcomes of Chinese Migrant Children	G	F	P	NA	E	E	E	E	n
R. Young, H. Sweeting and A. Ellaway	2011	Do schools differ in suicide risk? The influence of school and neighbourhood on attempted suicide, suicidal ideation and self-harm among secondary school pupils	E	E	P	NA	E	E	E	E	n
B. Zani, E. Cicognani and C. Albanesi	2001	Adolescent's sense of community and feeling of unsafety in the urban environment	G	F	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
S. Zeldin and D. Topitzes	2002	Neighborhood experiences, community connection and positive beliefs about adolescents among urban adults and youth	G	F	E	E	P	NA	NA	E	n
S. Browning and P. Erickson	2012	Neighbourhood Variation in the Link between Alcohol Use and Violence among Canadian Adolescents	G	F	P	NA	P	NA	NA	E	n
J. Delva, W. Lee, N. Sanchez, F. H. Andrade, A. Grogan-Kaylor, G. Sanhueza and M. Ho	2014	Ecological factors and adolescent marijuana use: results of a prospective study in Santiago, Chile	G	F	E	E	P	NA	NA	E	n
D. E. Jones, M. E. Feinberg, M. J. Cleveland and B. R. Cooper	2012	A multidomain approach to understanding risk for underage drinking: Converging evidence from 5 data sets	G	F	E	E	P	NA	NA	E	n
B. Kingston, D. Huizinga and D. S. Elliott	2009	A Test of Social Disorganization Theory in High-Risk Urban Neighborhoods	E	G	E	E	P	NA	NA	E	n
D. C. May	2001	The effect of fear of sexual victimization on adolescent fear of crime	E	E	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
M. L. Mayberry, D. L. Espelage and B. Koenig	2009	Multilevel Modeling of Direct Effects and Interactions of Peers, Parents, School, and Community Influences on Adolescent Substance Use	G	F	E	E	E	E	E	E	y
V. E. Nebbitt, M. Lombe, M. Yu, M. G. Vaughn and C. Stokes	2012	Ecological correlates of substance use in African American adolescents living in public housing communities: Assessing the moderating effects of social cohesion	E	E	E	E	P	NA	NA	E	n
G. Pretty, M. Rapley and P. Bramston	2002	Neighbourhood and Community Experience, and the Quality of Life of Rural Adolescents with and without an Intellectual Disability	G	F	P	NA	P	NA	NA	E	n
M. Prezza and M. G. Pacilli	2007	Current Fear of Crime, Sense of Community, and Loneliness in Italian Adolescents: The Role of Autonomous Mobility and Play during Childhood	E	E	E	E	P	NA	NA	E	n
E. F. Rothman, R. M. Johnson, R. Young, J. Weinberg, D. Azrael and B. E. Molnar	2011	Neighborhood-level factors associated with physical dating violence perpetration: results of a representative survey conducted in Boston, MA	G	E	E	E	P	NA	NA	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
L. M. Scheier, N. L. Miller, M. Ifill-Williams and G. J. Botvin	2001	Perceived neighborhood risk as a predictor of drug use among urban ethnic minority adolescents: moderating influences of psychosocial functioning	E	G	E	E	P	NA	NA	E	n
R. L. Simons, L. G. Simons, C. H. Burt, G. H. Brody and C. Cutrona	2005	Collective efficacy, authoritative parenting and delinquency: A longitudinal test of a model integrating community- and family-level processes	G	F	E	E	P	NA	NA	E	n
J. D. Sorribas, R. V. Banos and M. A. M. Gracia	2014	The Perception of Community Social Support among Young Foreign-Born People in Catalonia	G	F	E	E	E	E	E	E	y
D. J. Wiebe, W. Guo, P. D. Allison, E. Anderson, T. S. Richmond and C. C. Branas	2013	Fears of violence during morning travel to school	G	F	E	G	P	NA	NA	E	n
N. Wilson, S. L. Syme, W. T. Boyce, V. A. Battistich and S. Selvin	2005	Adolescent Alcohol, Tobacco, and Marijuana Use: The Influence of Neighborhood Disorder and Hope	E	E	E	E	E	E	E	E	y

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
I. Yun and E. Hwang	2011	A Study of Occasional and Intensive Weapon Carrying Among Adolescents Using a Nationally Representative Sample	E	E	E	E	P	NA	NA	E	n
P. Bramston, K. Bruggerman and G. Pretty	2002	Community perspectives and subjective quality of life	G	F	E	E	P	NA	NA	E	n
G. H. Brody, X. Ge, R. Conger, F. X. Gibbons, V. M. Murry, M. Gerrard and R. L. Simons	2001	The Influence of Neighborhood Disadvantage, Collective Socialization, and Parenting on African American Children's Affiliation with Deviant Peers	G	F	E	E	P	NA	NA	E	n
L. DeHaan and T. Boljevac	2010	Alcohol Prevalence and Attitudes among Adults and Adolescents: Their Relation to Early Adolescent Alcohol Use in Rural Communities	G	E	E	E	E	E	E	E	y
M. Little and L. Steinberg	2006	Psychosocial Correlates of Adolescent Drug Dealing in the Inner City: Potential Roles of Opportunity, Conventional Commitments, and Maturity	G	F	E	E	P	NA	NA	E	n
K. C. Nesbit, T. H. Kolobe, S. B. Sisson and I. R. Ghement	2014	A Model of Environmental Correlates of Adolescent Obesity in the United States	E	E	P	NA	E	E	E	E	n

			Quality Assessment								Include
Author	Year	Title	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	(y or n)
T. R. Williams, L. E. Davis, J. M. Cribbs, J. Saunders and J. H. Williams	2002	Friends, family, and neighborhood: Understanding academic outcomes of African American youth	G	F	P	NA	P	NA	NA	E	n
A. J. Sheidow, D. Gorman-Smith, P. H. Tolan and D. B. Henry	2001	Family and community characteristics: Risk factors for violence exposure in inner-city youth	G	F	E	E	P	NA	NA	E	n
L. M. Van Horn, D. J. Hawkins, M. W. Arthur and R. F. Catalano	2007	Assessing Community Effects on Adolescent Substance Use and Delinquency	G	E	P	NA	P	NA	NA	E	n

Appendix E

Ethics approval

University of St Andrews

University Teaching and Research Ethics Committee
Sub-committee

6th June 2014

Gina Martin
School of Medicine

Ethics Reference No: *Please quote this ref on all correspondence*	**MD11023**
Project Title:	**Socio-Environmental Characteristics, Adolescent Drinking Behaviours and Motivations in Scotland**
Researchers Name(s):	**Gina Martin**
Supervisor(s):	**Candace Currie and Joanna Inchley**

Thank you for submitting your application which was considered by School of Medicine Ethics Convener on the 6th June 2014. The following documents were reviewed:

1. Ethical Application Form YES
2. HBSC Scotland Data Management Protocol YES
3. HBSC Scotland Potentially Disclosive Data Prototocol YES

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years. Projects, which have not commenced within two years of original approval, must be re-submitted to your School Ethics Committee.

You must inform your School Ethics Committee when the research has been completed. If you are unable to complete your research within the 3 three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply.

Any serious adverse events or significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee, and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' https://www.st-andrews.ac.uk/utrec/guidelines/ are adhered to.

Yours sincerely

Dr Morven Shearer
Convenor of the School Ethics Committee

Appendix F

Sensitivity analysis-AOD=400m and 1000m

Table F.1: Sensitivity analysis-AOD=400m and 1000m on alcohol use outcomes

Variable	Ever Drank	
	400m	1000m
Sex (male)	1.02 (0.75,1.35)	1.01 (0.74,1.35)
Age	2.16 (1.30,3.32) **	2.09 (1.32,3.14) ***
Family Structure (Reference: both parents)		
single parent	1.30 (0.84,1.96)	1.31 (0.85,1.96)
step-family/other	2.01 (1.12,3.45)*	2.01 (1.12,3.43)*
Family Affluence (Reference: low)		
medium	1.52 (1.01,2.20) *	1.51 (1.00,2.19)
high	1.53 (1.03,2.19)*	1.51 (1.02,2.16)*
Ethnicity (white)	2.81(1.20,5.38)*	2.82(1.15,5.52)*
On trade licence density	0.98(0.96,1.01)	0.97(0.91,1.04)
Off trade license density	1.03 (0.97,1.09)	0.99 (0.84,1.17)
Urban/rurality (Reference: large cities)		
other urban	1.51 (0.87,2.46)	1.45 (0.82,2.42)
accessible small towns	2.09 (1.08,3.72)*	1.95 (0.97,3.57)
accessible rural	2.62 (1.39,4.55)**	2.37 (1.20,4.28)*
remote small towns	3.81(1.86,7.11)***	3.75(1.77,7.28)***
remote rural	3.76 (1.98,6.61)***	3.44 (1.71,6.24)***
Neighbourhood deprivation (Reference: 1 most deprived)		
2	1.29 (0.75, 2.10)	1.26 (0.73, 2.04)
3	1.04 (0.60, 1.68)	1.00 (0.57, 1.70)
4 least deprived	1.09 (0.61,1.80)	1.03 (0.57,1.70)
Neighbourhood social cohesion	0.35 (0.11,0.82)*	0.32 (0.10,0.79)*
Neighbourhood disorder	0.46 (0.07, 1.66)	0.45 (0.06, 1.64)
Perceived social cohesion	1.00 (0.93,1.07)	.99 (0.92,1.07)
Perceived disorder	1.24 (1.10,1.41) **	1.24 (1.10,1.40) ***
Neighbourhood variance	0.32 (0.03,0.69)	0.34 (0.06,0.73)
DIC	1293.17	1291.03

Variable	Weekly Drinkers	
	400 m	1000 m
Sex (male)	1.44 (1.10,1.85)**	1.43 (1.10,1.84)**
Age	1.11 (0.74,1.65)	1.13 (0.81,1.53)
Family Structure (Reference: both parents)		
single parent	1.47 (1.02,2.04)*	1.47 (1.02,2.04)*
step-family/other	1.13 (0.74,1.65)	1.13 (0.74,1.65)
Family Affluence (Reference: low)		
medium	1.25 (0.87,1.72)	1.25 (0.88,1.73)
high	1.25 (0.89,1.72)	1.26 (0.89,1.73)
Ethnicity (white)	0.66 (0.25, 1.42)	0.65 (0.26, 1.40)
On trade licence density	1.00 (0.97,1.02)	1.00 (0.95,1.07)
Off trade license density	0.99 (0.95,1.04)	0.97 (0.83,1.11)
Urban/rurality (Reference: large cities)		
other urban	1.24 (0.72,1.97)	1.24 (0.72,1.99)
accessible small towns	2.08 (1.14,3.54)*	2.02 (1.11,3.42)*
accessible rural	1.26 (0.71,2.10)	1.23 (0.67,2.12)
remote small towns	1.32 (0.72, 2.25)	1.28 (0.70, 2.18)
remote rural	1.38 (0.78,2.28)	1.34 (0.74,2.27)

Variable	Ever Drank	
	400m	1000m
Neighbourhood deprivation (Reference: 1 most deprived)		
2	0.91 (0.60,1.34)	0.90 (0.59,1.32)
3	0.80 (0.51,1.20)	0.79 (0.50,1.19)
4 least deprived	0.64 (0.40,0.98)*	0.63 (0.39,0.96)*
Neighbourhood social cohesion	1.37 (0.56,2.86)	1.37 (0.56,2.87)
Neighbourhood disorder	1.22 (0.26, 3.67)	1.22 (0.26, 3.64)
Perceived social cohesion	0.95 (0.89,1.01)	0.95 (0.89,1.00)
Perceived disorder	1.15 (1.04,1.27)**	1.14 (1.03,1.26)*
Neighbourhood variance	0.15(0.00,0.43)	0.15 (0.00,0.44)
DIC	1500.64	1499.82

Variable	Drunkenness	
	400m	1000m
Sex (male)	0.99 (0.77,1.25)	0.99 (0.77,1.24)
Age	1.28 (0.93,1.81)	1.22 (0.88,1.69)
Family Structure (Reference: both parents)		
single parent	1.36 (0.96,1.88)	1.37 (0.97,1.88)
step-family/other	2.03(1.35,2.95)**	2.03(1.36,2.96)**
Family Affluence (Reference: low)		
medium	0.94(0.68,1.27)	0.93(0.67,1.27)
high	1.27(0.93,1.71)	1.27(0.92,1.71)
Ethnicity (white)	0.67(0.26,1.39)	0.65(0.24,1.37)
On trade licence density	1.01(0.99,1.03)	1.04(0.99,1.10)
Off trade license density	1.02(0.97,1.06)	0.98 (0.86,1.12)
Urban/rurality (Reference: large cities)		
other urban	1.06(0.67,1.61)	1.11(0.70,1.69)
accessible small towns	2.22(1.30,3.54)**	2.26(1.31,3.63)**
accessible rural	1.31(0.79,2.04)	1.38(0.82,2.20)
remote small towns	1.46(0.87,2.30)	1.40(0.82,2.24)
remote rural	1.98 (1.21,3.08)**	2.26 (1.22,3.27)**
Neighbourhood deprivation (Reference: 1 most deprived)		
2	0.76(0.51,1.11)	0.74(0.50,1.07)
3	0.76(0.50,1.12)	0.74(0.49,1.08)
4 least deprived	0.71(0.46,1.06)	0.70(0.45,1.04)
Neighbourhood social cohesion	0.85(0.38,1.65)	0.85(0.38,1.65)
Neighbourhood disorder	2.41(0.60,6.65)	2.32(0.59,6.43)
Perceived social cohesion	1.00(0.95,1.06)	1.00(0.94,1.06)
Perceived disorder	1.09(0.99,1.19)	1.09(0.99,1.19)
Neighbourhood variance	0.05(0.00,0.21)	0.04(0.00,0.19)
DIC	1632.77	1630.97

Appendix G

Trajectory plots for drinking outcomes

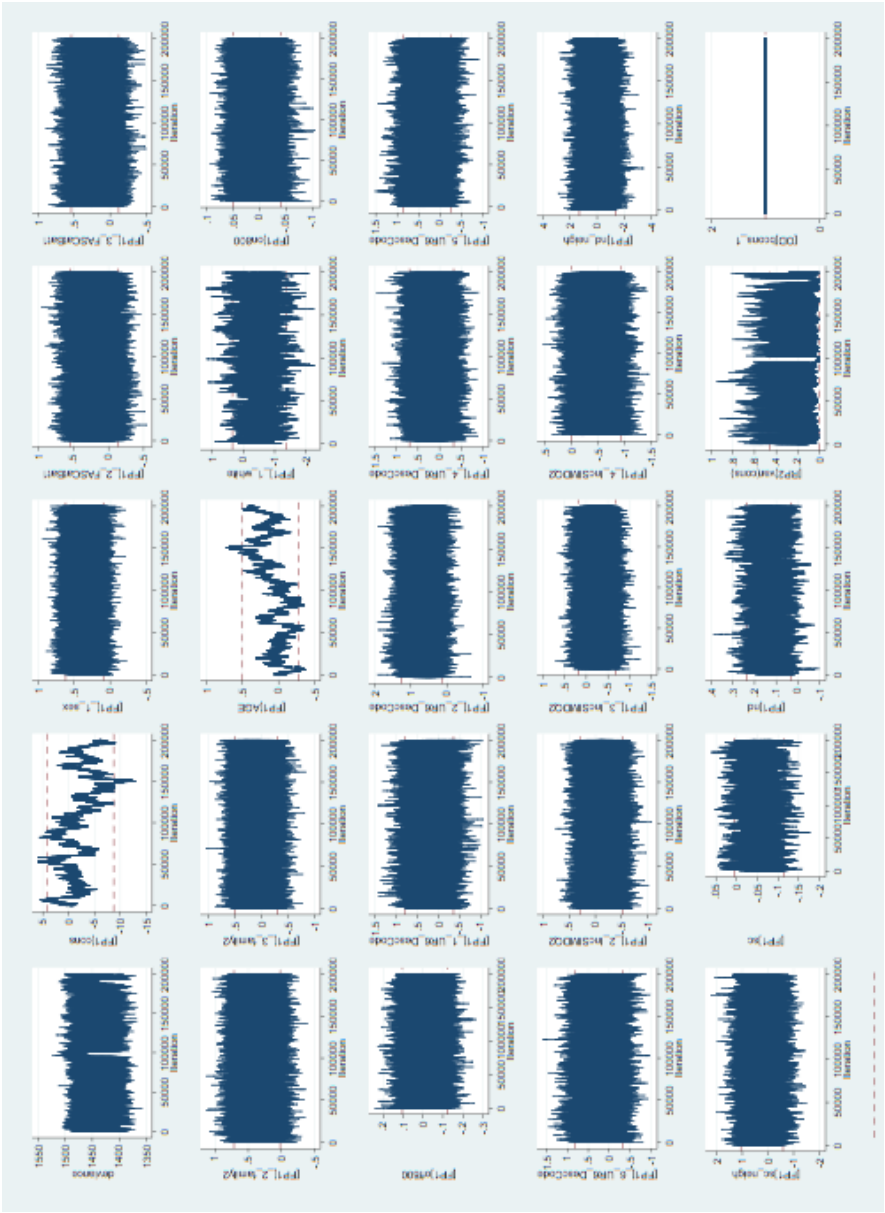


Figure G.1: Trajectory plots for model 8, outcome is weekly drinking

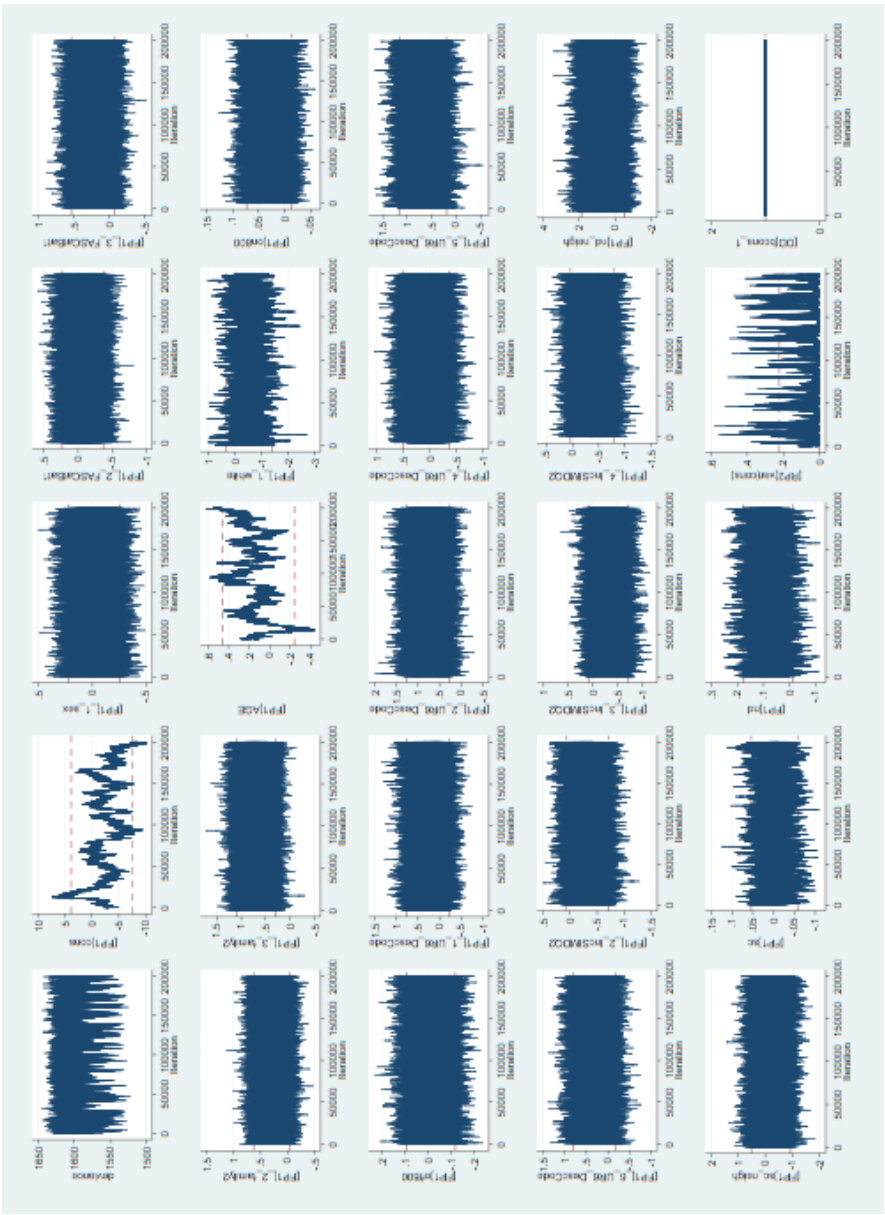


Figure G.2: Trajectory plots for model 8, outcome is drunkenness

Appendix H

Trajectory plots for drinking motives

Figure H.1: Trajectory plots for model 3, outcome is conformity motives

Figure H.2: Trajectory plots for model 3, outcome is enhancement motives

Figure H.3: Trajectory plots for model 3, outcome is coping motives

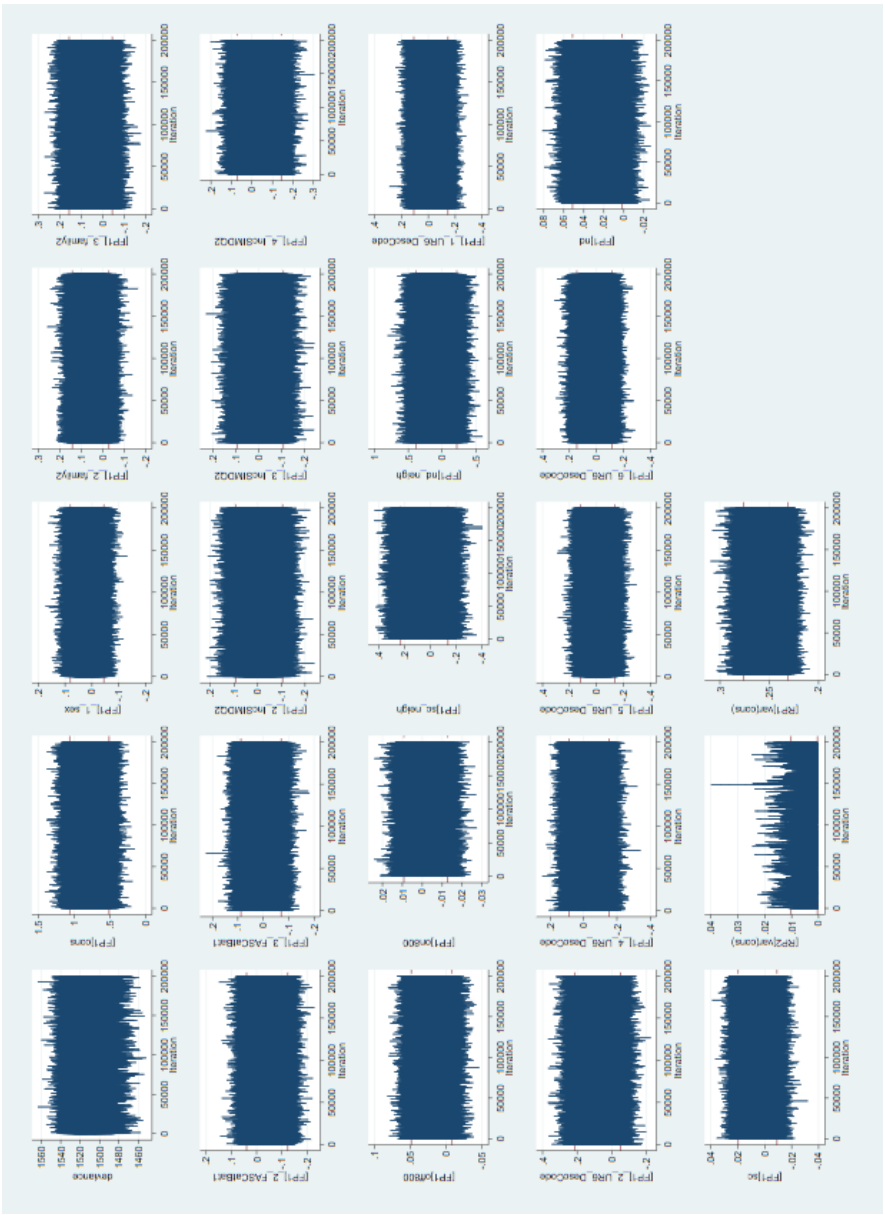


Figure H.4: Trajectory plots for model 3, outcome is social motives

Appendix I

Cross-classified models for coping motives

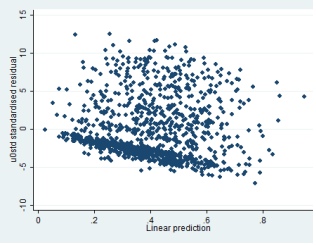
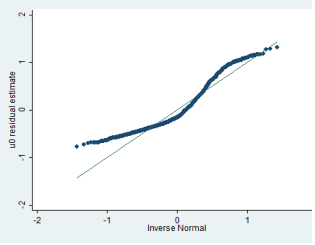
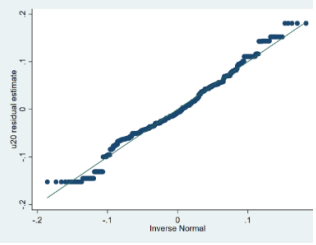
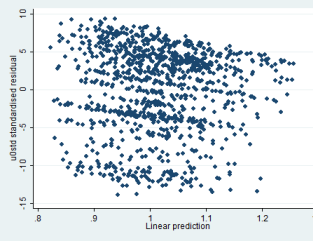
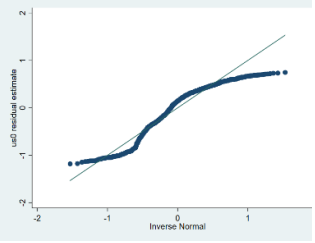
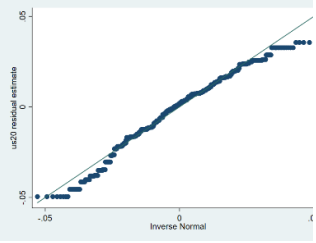
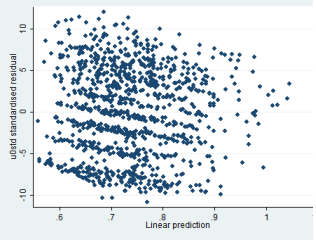
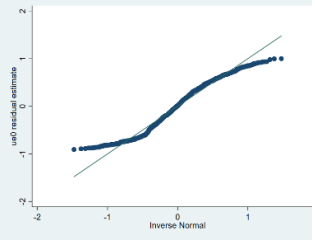
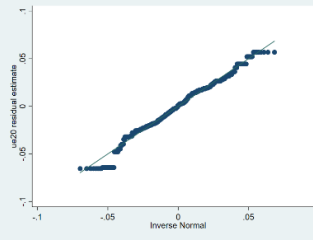
Table I.1: Cross-classified model for coping drinking motives

	B	[95% CI]	*p*-value
Male	-0.17	[-0.23,-0.11]	<0.001
Single Parent	0.07	[-0.01,0.15]	0.096
Other	0.04	[-0.05,0.13]	0.426
_2_FAS	-0.04	[-0.12,0.04]	0.324
_3_FAS	-0.02	[-0.09,0.06]	0.681
_2_IncSIMDQ2	-0.14	[-0.24,-0.05]	0.004
_3_IncSIMDQ2	-0.1	[-0.20,-0.00]	0.047
_4_IncSIMDQ2	-0.17	[-0.28,-0.06]	0.002
off800	-0.01	[-0.04,0.02]	0.397
on800	0	[-0.01,0.01]	0.774
Neighbourhood social cohesion	0.09	[-0.11,0.28]	0.381
Neighbourhood disorder	0.24	[-0.08,0.56]	0.146
Accessible rural	0.08	[-0.05,0.21]	0.232
Accessible small town	0.14	[-0.00,0.28]	0.053
Other urban	0.07	[-0.06,0.19]	0.297
Remote rural	0.02	[-0.11,0.16]	0.715
Remote small town	0.11	[-0.03,0.25]	0.118
Perceived disorder	0.02	[0.00,0.05]	0.041
Perceived social cohesion	-0.01	[-0.02,0.00]	0.107
School variance	0.01	[0.00,0.02]	
Neighbourhood variance	0.01	[0.00,0.02]	
Individual variance	0.22	[0.20,0.25]	
Bayesian DIC	1475.11		

Appendix J

Residual plots

Residual plots for models where drinking outcome is the outcome (Model 3)

Outcome	Predicted by Standardised Residuals	Q Normal Plot of Model Residuals-Level 1	Q Normal Plot of Model Residuals-Level 2
coping			
social			
enhancement			
conformity